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CSD 5597-93-2

BSM DELTA QUALIFICATION 2 FINAL REPORT

Volume III, Book 2

11 November 1994

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UNITED TECHNOLOGIES CHEMICAL SYSTEMS

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CSD 5597-93-2

BSM DELTA QUALIFICATION 2 FINAL REPORT

Volume III, Book 2

11 November 1994

Submitted to:

USBI
Huntsville, AL

Prepared by



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FOREWORD

This report, presented in three volumes, provides the results of a two-motor Delta Qualification 2 program conducted in 1993 to certify the following enhancements for incorporation into Booster Separation Motor (BSM) flight hardware:

- Vulcanized-in-place nozzle aft closure insulation
- New iso-static ATJ bulk graphite throat insert material
- Adhesive EA 9394 for bonding the nozzle throat, igniter grain rod/centering insert/igniter case
- Deletion of the igniter adapter insulator ring
- Deletion of the igniter adapter/igniter case interface RTV
- Deletion of Loctite from igniter retainer plate threads.

The enhancements above directly resulted from (1) the BSM Total Quality Management (TQM) Team initiatives to enhance the BSM producibility, and (2) the necessity to qualify new throat insert and adhesive systems to replace existing materials that will not be available.

Testing was completed at both the component and motor levels. Component testing was accomplished to screen candidate materials (e.g., throat materials, adhesive systems) and to optimize processes (e.g., aft closure insulator vulcanization approach) prior to their incorporation into the test motors. Motor testing — consisting of two motors, randomly selected by USBI's on-site quality personnel from production lot AAY, which were modified to accept the enhancements — were completed to provide the final qualification of the enhancements for incorporation into flight hardware.

This report addresses the motor level test results, with summary discussions of the component level testing where appropriate. Volume I discusses the results obtained from the Delta Qualification 2 testing. Volume II details the environmental testing (vibration and shock) conducted at Marshall Space Flight Center (MSFC) to which the motors were subjected prior to static testing. Volume III provides various supporting documentation to Volumes I and II, including the analyses and plans that governed the testing of the two Delta Qualification units.

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DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (AFT)	REL. #: MFGA 96534	PAGE 6 OF 18
	PART #: B12000-14-01-501	DAR REV: BASIC

ITEM CAT ZONE METHODS CODE SOURCE / INSPECTION INSTRUCTIONS	DATA MANAGEMENT: DESIGN LIMITS MIN.	DESIGN LIMITS MAX.	DATA RECORDING	FINAL ACCEPTANCE: OPER STP-DT	QUALITY STP-DT	CUST/GOV STP-DT

PD001 III --- VIS REC C1

RECORD TORQUE OF GROUND STRAP TO CONTAINER. (N/A IF GROUND STRAP PREVIOUSLY INSTALLED.)

45 IN-LB 55 IN-LB WRENCH S/N: _____

TORQUE: _____ IN-LB

N/A P 141 CVS

T 9/3/93

PD002 I --- VIS VER C1,P1

MOTOR CONDITION IS ACCEPTABLE. QUALITY CONTROL, GOVERNMENT QUALITY ASSURANCE, AND USBI INSPECT.

ACCEPTABLE

116 GOV'T

USBI

PD003 I --- VIS VER C1,P1

Q.C. VERIFY SECURITY BAG AND LEAD SEAL IS PROPERLY SECURED. GOV'T VERIFY.

116 GOV'T

PD004 IIM --- VIS VER C1

VERIFICATION OF HUMIDITY INDICATOR AND RELIEF VALVE IS TIGHT.

PD005 IIC --- VIS VER C1

RECORD TORQUE OF GROUND STRAP TO MOTOR. 50 IN-LB 55 IN-LB WRENCH S/N: J11C01643

TORQUE: 50 IN-LB

P 141 CVS 9/3/93

3331

T 9/3/93

DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (AFT)	REL. #: MFGA 96534	PAGE 7 OF 18
	PART #: B12000-14-01-501	DAR REV: BASIC

ITEM CAT ZONE METHODS CODE SOURCE / INSPECTION INSTRUCTIONS	DATA MANAGEMENT: DESIGN LIMITS MIN.	DESIGN LIMITS MAX.	DATA RECORDING	FINAL ACCEPTANCE: OPER STP-DT	QUALITY STP-DT	CUST/GOV STP-DT
PD006 IIC --- VIS REC C1 RECORD TORQUE OF TIE-RODS.	20 IN-LB	22 IN-LB	WRENCH S/N: J1100170S TORQUE: 21 IN-LB		T 9/3/93	
PD007 IIM --- VIS VER C1 INSTALLATION OF (12) DESICCANT BAGS.	16	---	ACCEPTABLE		P 141 C S 9/3/93	
PD008 IIC --- VIS VER C1 RECORD TORQUE OF LOCKRING.	66 IN-LB	78 IN-LB	WRENCH S/N: J1100168Z TORQUE: 75 IN-LB		333 C S T 9/3/93	
PD009 IIM --- VIS VER C1,P1 VERIFICATION OF HUMIDITY INDICATOR. GOV'T VERIFY.	---	40%	ACCEPTABLE		116 C 80	GOVT
PD010 IIM --- VIS VER C1 INSTALLATION OF Q.C. SEAL. USBI INSPECT.			ACCEPTABLE		116 C 80	USBI BPC 25 BPC
PC001 IV --- VIS VER C2 PALLETS PROPERLY LABELED. PALLET LIST FORWARDED TO ENGINEER.	---	---	ACCEPTABLE		P 141 C S 9-3-93	

DATA ACCEPTANCE RECORD

ATK TECHNOLOGIES CHEMICAL SYSTEMS

PCS 040217 PG 5 OF 5

TITLE: BSM ENVIRONMENTAL ROCKET MOTOR UNPACKAGE (AFT)	Q.E. APPROVAL	DATE	REL NO. MFGA 96534	PAGE 8A OF 18
			PART NO. B12000-14-01-521	DAR REV BASIC

ITEM	CAT	ZONE	METHODS	CODE	SOURCE	INSPECTION INSTRUCTIONS	DATA MANAGEMENT: DESIGN LIMITS MINIMUM	DESIGN LIMITS MAXIMUM	DATA RECORDING	FINAL ACCEPTANCE: OPERATOR STP-DATE	QUALITY STP-DATE	CUST/GOV STP-DATE
PD001	III	-	VIS	VER	C2	Q.C. VISUAL INSPECT CONTAINER FOR DAMAGE. USBI VISUALLY INSPECT.	---	---	SEE COMMENT SHEET, ITEM # 1	OCT 07 1993	OCT 07 1993	
PD002	III	-	VIS	REC	C1	Q.C. VERIFY MOTOR AND CONTAINER S/N ARE THE SAME (N/A LINES NOT USED).	---	---	MOTOR S/N 1000134 N/A; CONTAINER S/N 1000734 N/A			OCT 07 1993
PD003	III	-	VIS	VER	C2,G2	Q.C. VISUAL INSPECT MOTOR FOR DAMAGE. AFQC & USBI WITNESS.	---	---	SEE COMMENT SHEET, ITEM # 2A; NCR D12394	OCT 07 1993		

415

10-7-93 10-22-93 10-25-93 10/25/93

DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (AFT)

REL. #: MFGA 96534 | PAGE 8 OF 18

PART #: B12000-14-01-501 | DAR REV: BASIC

ITEM CAT ZONE METHODS CODE SOURCE / INSPECTION INSTRUCTIONS	DATA MANAGEMENT: DESIGN LIMITS MIN. MAX.	DATA RECORDING	FINAL ACCEPTANCE: OPER STP-DT	QUALITY STP-DT	CUST/GOV STP-DT
PD011 IIC --- VIS VER G2 GOV'T. VERIFY PALLETIZATION OF MOTORS AND INSTALLATION INTO VEHICLE.		ACCEPTABLE			GOVT 9-3-93
PD012 IIM --- VIS VER C2,G2 Q.C. AND GOV'T FINAL INSPECTION OF TRANSPORTATION CONDITION.		ACCEPTABLE			GOVT 116 C80 9-3-93
D014 III --- VIS REC C1 RECORD RESULTS OF VISUAL INSPECTION. GOVT INSPECT MOUNTING AND AERO HEAT SHIELD HOLES. (PCS 040223)		NO ANOMALIES	Loss. NCR D12394 See comment sheet Item 3A + NCR D12394 Item 1 thru 3	293 C80 10-7-93	USBI 293 C80 10/12/93 OCT 22 1993
D015 II NOTE 7 VER C2 ALCOHOL WIPE WITNESS		ACCEPTABLE			USBI 600 10-7-93
					USBI 66 OS 10-12-93
					GOVT 10-12-93
			NCR D12394 Item 4 + 5		GOVT 10-25-93

Nondestructive Inspection
Alcohol Liquid Penetrant
Visual Examination Data Sheet

WORK INSTRUCTION/TECHNIQUE: 60.12.9-420-003	REVISION: 2	WORK ORDER NUMBER: 5537-996-0[illegible]
CLEANER USED (IF REQUIRED): NONE	BATCH NO.: NONE	DRYING TIME: NONE
ALCOHOL TYPE: ISOPROPYL	BATCH NO.: 2576	DWELL TIME: 5 SECON
ACCEPTANCE CRITERIA: DRAWING NOTE 7		
REFERENCE NCR NO. (IF APPLICABLE): NONE	PLANNING NO./NCR NO.: MFGA 96534	
DRAWING NO./PART NO.: ~~B12003 -01~~ B12000-14 Ba-501	ITEM DESCRIPTION: BSM NOZZLE ASSY. (GRAPHITE THROAT)	

250 CSD 10-12-93

ITEM IDENTIFICATION SERIAL NUMBER	INDICATION DESCRIPTION/REMARKS	VISUAL	LIQUID
1,000,734	NO INDICATIONS NOTED	X	X

SKETCH

INSPECTOR: Michael Peele LEVEL: 68 CS II DATE: 10-12-93

CSD 2732 (92/06)

DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (AFT)	REL. #: MFGA 96534	PAGE 9 OF 18
	PART #: B12000-14-01-501	DAR REV: BASIC

ITEM CAT ZONE METHODS CODE SOURCE / INSPECTION INSTRUCTIONS	DATA MANAGEMENT			FINAL ACCEPTANCE		
	DESIGN LIMITS		DATA RECORDING	OPER	QUALITY	CUST/GOV
	MIN.	MAX.		STP-DT	STP-DT	STP-DT

D016 III --- VIS REC C1

RADIOGRAPHIC INSPECTION.

X-RAY COMPLETED
MOTOR ACCEPTABLE

USBI 680 10-13-93 GOVT

PC002 III SMI VER C3

MOTOR INTERIOR INSPECTION * Inspect Weather Seal installation. (Pcs 41834)

NO DAMAGE

ACCEPTABLE

293 CSD OCT 25 1993

VOID MR 10-14-93 293 CSD OCT 14 1999

USBI BPC 10-25-93 GOVT

SEE COMMENT SHEET, ITEM # 35

PC003 III - VIS REC C3

MOTOR SERIAL NUMBER, SYSTEM DATA CHART.

--- ---

S/N: 1000734

SDC: 160-93

807 CSD 11-02-93

UNITED TECHNOLOGIES

Radiographic Inspection Repo

PART NUMBER	REV. / ECO'S	PROJECT	NDT LAB CONTROL NO.
B12000-14-01-501	#1 NONE	5597	93100768

PART/MATERIAL NAME: BSM DELTA QUAL MOTOR TEST (AFT)

SPECIFICATION: SE0727

PROCEDURE/PLAN NO: REL# 96534

NCR NO: NONE

QUANTITY			
RECEIVED	INSPECTED	ACCEPTED	REJECTE
1	1	1	-0-

SERIAL NO./VIEW	ACC.	REJ.	REMARKS/DESCRIPTION
1000734			
0°	X		NO INDICATIONS NOTED
45°	X		
90°	X		
135°	X		

TECHNIQUE

Work/instruction No. 60.12.9-217

(or fill in below)

EQUIPMENT

KV/MEV

MA/RADS

TIME

FFD

MATERIAL THICKNESS

VIEWS

PENETRAMETER

PENETRAMETER BLOCK

FILM TYPE

SCREENS

CASSETTES

DENSITY

SENSITIVITY

DEVELOPMENT

FILM USED

SKETCH OR PHOTO

INTERPRETER: [signature]

DATE: 10/13/93

R 33 T CS

CSD 1430C (89/07)

DISTRIBUTION: WHITE — WITH O&QR CANARY ... PINK — FILE

PAGE 1 OF 1

DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (AFT)	REL. #: MFGA 96534	PAGE 10 OF 18
	PART #: B12000-14-01-501	DAR REV: BASIC

ITEM CAT ZONE METHODS CODE SOURCE INSPECTION INSTRUCTIONS	DATA MANAGEMENT			FINAL ACCEPTANCE		
	DESIGN LIMITS		DATA RECORDING	OPER	QUALITY	CUST/GOV
	MIN.	MAX.		STP-DT	STP-DT	STP-DT

PC004 III TABLE II SMI VER C1

PRE-TEST AND POST-TEST MEASUREMENTS

CALB.
#J10401465

			PRE-TEST	POST-TEST
1.	FINAL ASSEMBLY WEIGHT (INC.CDF)		162.0 LBS	845 LBS
2.	THROAT DIAMETER, IN. (FOUR EQUALLY SPACED MEASUREMENTS)	0°	3.138	3.153
		45°	3.140	3.156
		90°	3.138	3.148
		135°	3.137	3.141
3.	EXIT DIAMETER, IN. (FOUR EQUALLY SPACED MEASUREMENTS)	0°	7.560	7.548
		45°	7.559	7.543
		90°	7.559	7.545
		135°	7.559	7.543
4.	BAROMETRIC PRESSURE, IN.HG.		29.21	29.21
5.	RELATIVE HUMIDITY, %		34 %	34 %
6.	AMBIENT TEMPERATURE, °F		72°	73°

CSD/QC STP/DT PRE-TEST
CSD/QC STP/DT POST-TEST
CSD/QC STP/DT PRE-TEST
CSD/QC STP/DT POST-TEST

1 11/2/93 11-5-93
2 11/2/93 11-5-93
3 11/2/93 11-5-93
4 11-2-93 11-2-93
5 11-2-93 11-2-93
6 11-2-93 11-2-93

USBI 680

D017 III VIS VER C2

TORQUE DATA FOR TBI(S) AND/OR ADAPTER INSTALLATION. 325 IN-LB 375 IN-LB WRENCH S/N: 1100 1408

TORQUE: 350 IN-LB

T 11/2/93

420

TITLE: BSM DELTA QUAL MOTOR TEST (AFT)

DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

REL. #: MFGA 96534 | PAGE 11 OF 18

PART #: B12000-14-01-501 | DAR REV: BASIC

ITEM CAT ZONE METHODS CODE SOURCE / INSPECTION INSTRUCTIONS	DESIGN LIMITS MIN.	DESIGN LIMITS MAX.	DATA MANAGEMENT / DATA RECORDING	FINAL ACCEPTANCE OPER STP-DT	FINAL ACCEPTANCE QUALITY STP-DT	FINAL ACCEPTANCE CUST/GOV STP-DT
PD013 III SE0837 SMI REC **FIG. 1** INSTALLATION OF LUBRICATED AS568A-904 O-RING, AND RECORD TORQUE OF AN815-4S UNION INTO PRESSURE PORT.	50 IN-LB	60 IN-LB	WRENCH S/N: J1100185 TORQUE: 60 IN-LB	T 11/2/93		
D018 COMPLETION OF INSTRUMENTATION.						
PD014 III SE0837 4.2.3.2 VIS REC C1,G1 STABILIZATION AND CONDITIONING.	15°F or 130°F	20°F or 135°F	TEMP: 16°F / 18°F TIME: 00:46 DATE: 11-03-93	867 CSD 11/2/93	105 11-2-93	USBI 11/2/93
PC005 III --- VIS VER C1,P1 COMPLETION OF CST.	---	---	ACCEPTABLE	105 11-8-93	105 11/3/93	105 11-05-93
D019 III SE0837 4.2.3.2 VIS VER C2 MOTOR CONDITIONING.	15°F or 130°F	20°F or 135°F	TEMP: 18 TIME: 14:22 DATE: 11/4/93	105 11-4-93	105 11-4-93	USBI 680 11-4-93
	24 HR	---	ACCEPTABLE	105 11/4/93		

421

DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (AFT)	REL. #: MFGA 96534	PAGE 12 OF 18
	PART #: B12000-14-01-501	DAR REV: BASIC

ITEM CAT ZONE METHODS CODE SOURCE / INSPECTION INSTRUCTIONS	DATA MANAGEMENT: DESIGN LIMITS MIN.	MAX.	DATA RECORDING	FINAL ACCEPTANCE: OPER STP-DT	QUALITY STP-DT	CUST/GOV STP-DT
D020 III SE0837 4.2.3.2 VIS REC C1						
REMOVAL OF MOTOR FROM CONDITIONING.	---	---	TIME: 14:22			
TOTAL CONDITIONING TIME. GOVT VERIFY	24 HR	—	DATE: 11/4/93	CSD 11-4-93		GOVT ENGR 23
D021 III SE0837 4.2.3.2 VIS REC C2			TOTAL 37:32 HOURS			
FIRING. Pcs 41841			TIME: 14:54	ENGR		
RECORD TOTAL TIME OUT OF CONDITIONING. Q.C. VERIFY ~~30 MIN. MAXIMUM OUT OF CONDITIONING IS MET~~.	---	~~30 MIN~~	DATE: 11/4/93 OUT: 32 MIN	CSD 11-4-93	105 11-4-93	USBI 680 11-4-93
Record motor case MPBT (Plotted) temperature 105 11-4-93 CSD 11/4/93	20°F	25°F	22.2 °F	Kacey Murphy BSM Proj. Engr. 11/4/93		
Record Ambient temperature.	—	—	72 °F			

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DELTA QUAL MOTOR TEST (AFT)

DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

REL. #: MFGA 96534

PART #: B12000-14-01-501

DAR REV: BASIC

ITEM	CAT	ZONE	METHODS	CODE	SOURCE	INSPECTION INSTRUCTIONS	DESIGN LIMITS MIN.	DESIGN LIMITS MAX.	DATA MANAGEMENT / DATA RECORDING	FINAL ACCEPTANCE OPER STP-DT	FINAL ACCEPTANCE QUALITY STP-DT	FINAL ACCEPTANCE CUST/GOV STP-DT
PD015	III	BDN-371-90	VIS	REC	C2	STATUS OF BLASTING CAP(S). STATUS OF CDF(S). STATUS OF TBI(S). P/N AND S/N OF ANY COMPONENT THAT DID NOT FIRE. (RECORD "N/A" IF ALL COMPONENTS FIRED.)			CAP(S) FIRED: YES CDF(S) FIRED: YES TBI(S) FIRED: YES BLASTING CAP(S): P/N: N/A S/N: N/A CDF(S): P/N: N/A S/N: N/A TBI(S): P/N: N/A S/N: N/A	23 11-4-93	105 11-4-93	USBI 680 11-4-93
PC006	III	---	VIS	VER	C2	TEST COMPLETION.	---	---	VERIFY	ENGR 23 11-4-93	105 11-4-93	USBI 680 11-4-93 GOVT 11-4-93
PD016	III	BDN371-90	VIS	VER	C1	TBI(S) AND IGNITER S/N(S).	---	---	TBI S/N: 0002906 TBI S/N: 0002967 IGNITER: 5568	23 11/1/93		

(PCS 04032-1)

DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (AFT)	REL. #: MFGA 96534	PAGE 14 OF 18
	PART #: B12000-14-01-501	DAR REV: BASIC

ITEM CAT ZONE METHODS CODE SOURCE / INSPECTION INSTRUCTIONS	DATA MANAGEMENT: DESIGN LIMITS MIN.	DESIGN LIMITS MAX.	DATA RECORDING	FINAL ACCEPTANCE: OPER STP-DT	QUALITY STP-DT	CUST/GOV STP-DT

PD017 III TABLE II SMI VER C1
IGNITER WEIGHT.

--- --- SEE COMMENT SHEET, ITEM # 7

WEIGHT: 5.200 Lbs

P 141 C S NOV 0 9 1993

PD018 III BDN371-90 VIS REC C2
CASE OF NOZZLE S/N(S)

--- --- CASE S/N: 10705

NOZZLE S/N: 10705

P 141 C S NOV 0 9 1993

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PD019 III TABLE II SMI VER C1
NOZZLE WEIGHT, THROAT AND EXIT CONE DIAMETERS. USBI WITNESS. GOVT WITNESS.
(PCS 040223)

--- --- NOZZLE WEIGHT: 28.35 Lbs

P 141 C S NOV 0 9 1993

293 C50 NOV 0 9 1993

USBI BPC 40H NOV 0 9 1993

THROAT DIAMETERS:
45° 3.137"
90° 3.142"
180° 3.134"
~~270°~~ 135 3.138"

SEE COMMENT SHEET, ITEM # 7

SEE COMMENT SHEET, ITEM # 8

EXIT DIAMETERS:
45° 7.533
90° 7.540"
180° 7.537"
~~270°~~ 135 7.538"

GOVT NOV 0 9 1993

E001 III T.P. VIS REC C1
ENGINEER COMPLETE THE FOLLOWING INSPECTION PLAN. GOVT INSPECT TBI'S, IGNITER, IGNITER BOND LINES, AND MOTOR INTERIOR.
(PCS 040223)

ENGINEER Larry C. Murphy 11/9/93

ENGR [ ] [ ] USBI [ ]

GOVT [ ]

TITLE: BSM DELTA QUAL MOTOR TEST (AFT)	REL. #: MFGA 96534	PAGE 15 OF 18
	PART #: B12000-14-01-501	DAR REV: BASIC

POST TEST INSPECTION PLAN

DESCRIBE IN DETAIL ALL OF THE FOLLOWING ITEMS ANSWERED "YES" ON COMMENT SHEET. RECORD ALL UNUSUAL ITEMS AS WELL AS APPROPRIATE PHOTOS TO FULLY DOCUMENT MOTOR AND CLOSURE CONDITION.

1) Motor Inspector (Before Dis-assembly)

a) Examine the exterior of the motor case. Are there any sign of bulges, discoloration, or signs of gas flow? ☐ Yes ☑ No

b) Examine the nozzle sub-assembly.

- Are there any discolorations or signs of gas flow external to nozzle? ☐ Yes ☑ No
- Any unusual flow patterns on nozzle exit cone? ☐ Yes ☑ No
- Throat insert out of place? ☐ Yes ☑ No
- Throat insert condition abnormal? ☐ Yes ☑ No

c) Examine the igniter assembly exterior. Is there any discoloration or signs of gas flow? ☐ Yes ☑ No ☐ N/A (if not in place)

2) Aft Closure (After Dis-assembly).

Note: The design intent is for none of the following events to occur.

a) Examine the 2 O-ring seal areas of the Aft closure.

(Do not remove the O-rings at this time)
Is there an evidence of gas leak or O-ring char or ablation? ☐ Yes ☑ No
Any evidence of O-ring groove or O-ring seal surface damage? ☐ Yes ☑ No

b) Any evidence of thread damage? ☐ Yes ☑ No

c) Any evidence of unusual ablation to aft closure insulation? ☐ Yes ☑ No

3) Motor Case Insulation.

After disassembly of the motor, visually examine the motor case interior (using APPROPRIATE lighting and inspection equipment). Record the conditions listed below. (The design intent is for none of the following events to occur).

a) Examine the 2 O-ring seal areas at the igniter interface. Is there any evidence of gas leakage or O-ring char or ablation? ☐ Yes ☑ No

b) Examine the 2 O-ring seal areas of the closure interface. Is there any EVIDENCE of gas leakage? ☐ Yes ☑ No

c) Are there any signs of irregular erosion? ☐ Yes ☑ No

4) Igniter Assembly.

(The design intent is for none of the following events to occur.)

a) Examine the O-ring seal areas of the igniter. (Do not remove the O-ring at this time.) Is there any evidence of gas leakage or O-ring char or ablation? ☐ Yes ☑ No

b) Is there any discoloration, indication of excessive heating, or signs of gas flow? ☐ Yes ☑ No

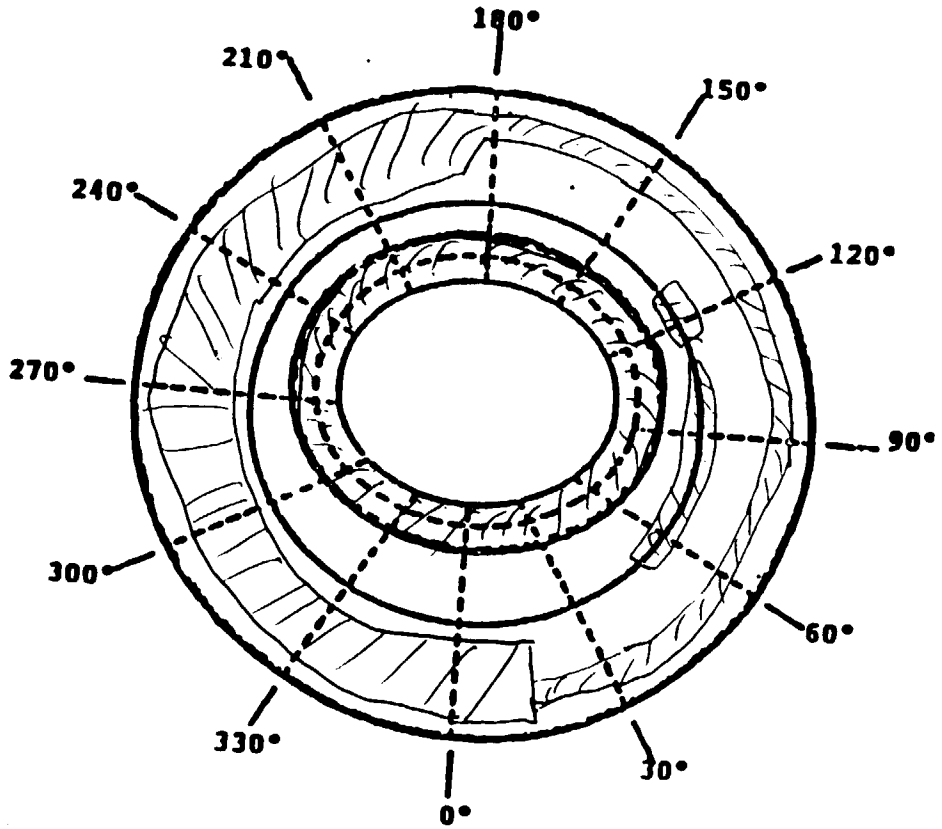
c) Did both initiators (TBIs) fire? ☑ Yes ☐ No

d) Post Test dissection. ☐ Yes ☐ No

e) Examine TBI sealing areas for evidence of gas leakage. ☐ Yes ☑ No

FIGURE 1

BSM CLOSURE-TO-INSULATOR BOND MAP



Ultrasonic Report/ Calibration Sheet

Page 1 of 2

PART NAME: BSM DELTA QUAL METER TEST	WORK ORDER NUMBER: 5597-956-0000
PART NUMBER: B12000-14-01-501	PLANNING DOCUMENT INFO. Release No.: MFGA 96534 / NCR No. (If applicable): NONE
Material: RUBBER	Component Serial No.: 1,000,734 / Project Name:
Specification/technique: SE1754 / 60.12.9-553	CALIBRATION CHECKS Initial: Time 0830
Quantity: Received 1 / Inspected 1 / Accepted ENG / Rejected INFO	Intermediate: Time —
Instrument/Serial Number: SONIC MK II Calibration Date: 10-4-94	Final: Time 0930
Transducer — Size/Frequency — Serial Number: .25/10MHz/922681	INSTRUMENT SETTINGS: Sweep C: F: / Delay C: F: / dB: Reject On Off / Frequency:
Scanning Method: CONTACT	
Test Blocks/Standards: STD K371	
COUPLANT: ULTRAGEL II	

EXAMINATION AREA	COMMENTS
see COMMENTS	UNABLE TO INSPECT APPROX 40 SQ IN OF CLOSURE BECAUSE OF SURFACE ROUGHNESS DUE TO FIRING. see MAP PAGE 17 OF 18

Michael Reeb 47 CS — Inspector

II — Level

11-10-93 — Date

CSD 2795 (92/03)

BLANK

TAP TEST EXAMINATION
DATA SHEET

PART NAME (NOZZLE ASSY)	PART NUMBER/~~DRAWING/REV~~ AV 11-2-93	PLANNING DOCUMENT #
BSM, DELTA QUAL	B12000-13-01-501	MFGA 9653
WORK INSTRUCTION — TECH #	**ACCEPT/REJECT CRITERIA**	**HAMMER SIZE**
60 12.9-590-001	PER ENG. INFO ONLY	.50 CZ
TYPE OF MATERIAL	**NCR #**	**PROJECT NO/WOR #**
RUBBER	N/A	5597/5597-986-000 C

ITEM S/N	IDENTIFICATION DESCRIPTION/REMARKS	ACC	REJ
1,000,734	NO UNBONDS NOTED.	E	
		N	
		G.	
		F	
		N	
		FO.	
		O	
		N	
		L	
		Y	

SKETCH

INSPECTOR Adrian Vazquez Jr. (15 UT)

LEVEL II

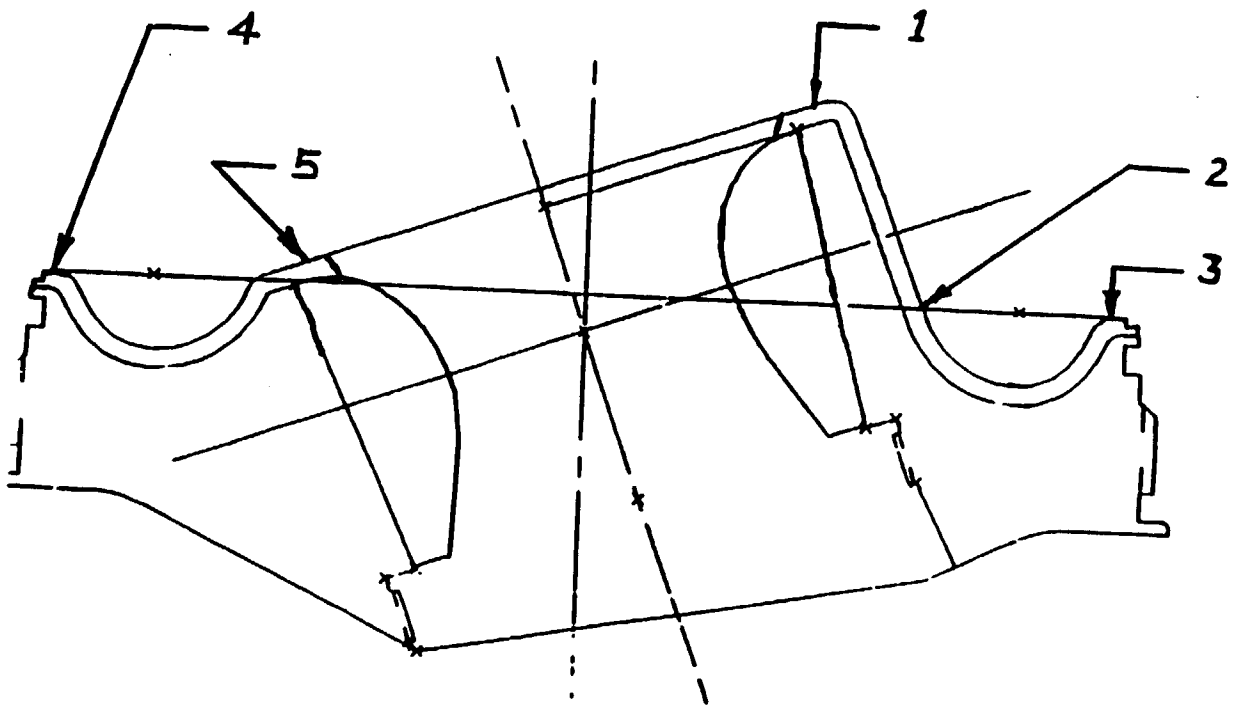
DATE 11-10-93

CSD 3059 (92/08)

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FIGURE 2

POST-TEST INSULATOR THICKNESS



DRAWING AND SPECIFICATION ACCOUNTABILITY LOG

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

P/N: B12000-14-01-501

RELEASE NO. MFGA 96534

REV: *1

THIS CERTIFIES THAT THE FOLLOWING CLASS II CHANGES HAVE NOT BEEN INCORPORATED INTO THE JOB RELEASE PACKAGE (JRP) FOR FABRICATION.

DRAWING REVISION EXCEPTIONS: N/A, _____, _____, _____, _____

PRODUCT PLANNER: K Reneta 8/27/93

BRANCH ENGINEER: [signature] 8/27/93

DOCUMENT NO.	REV	ECO's/ SCN's	TITLE	PI/MSI NUMBERS	INCORPORATED PCS NUMBER	JRP DOCUMENT (MAT/DAR/PL)	INCORPORATED PCS NUMBER
07.9.007	0		BSM Delta Qual Rocket Motor				

CSD 2800 (89/05)

Comment Sheet

PART NO.	SERIAL NO.	PLAN REV.	REL. NO.
B12000-14-01-501	1000734	Basic	MFG A~~96734~~ 96554

DESCRIPTION
BSM DELTA QUAL MOTOR TEST (FWD)

9-3-93

ITEM NO.	STEP NO.	COMMENT:
01	D003	

Chart # 1 has out of conditioning situation for one minute . With makeup time 2 minutes were deducted from total time . Total condition time is corrected.

ORIGINATOR:	DATE:	ORGANIZATION:
B.R. Patel	9-3-93	01840

ITEM NO.	STEP NO.	COMMENT:
02	D005	

Chart # 2 cold cycle has 5 spikes on high temp. side and 4 spikes on low temp. side. These spikes are due to compressor cycling (noise) . Total time is corrected. Spike duration is less than 2 seconds.

ORIGINATOR	DATE:	ORGANIZATION:
B.R. Patel	9-3-93	01840

ITEM NO.	STEP NO.	COMMENT:
03	D008	

In Chart # 4 there two spikes on cold temp. and 10 spikes on high temp. These spikes are due to compressor cycling (noise). Spike duration is less than 2 seconds.

ORIGINATOR:	DATE:	ORGANIZATION:
B.R. Patel	9-3-93	01840

ITEM NO	STEP NO.	COMMENT:
04.	D013	

In Chart # 6 there are seven spikes on on high temp. and five on cold temp. . These spikes are due to compressor cycling (noise) Spike duration is less than 2 seconds.

ORIGINATOR:	DATE:	ORGANIZATION:
B.R. Patel	9-3-93	0184

CSD 2489 (8/93)

DISTRIBUTION: WHITE - STAY WITH JRP
PINK - UPON CLOSEOUT OF JRP, SHOP SUPERVISOR TO FORWARD T OORIGINATING PLANNER

C O M P L E T I O N M A T E R I A L H A N D L E R

PLANT CODE : 001 PLANNER:
PART NUMBER: B12000-14-01-501
JOB NUMBER : MFGA96534-01

MFGA96534-01

CONTRACT NUMBER : 559X
DESCRIPTION : ROCKET MOTOR ASSEMBLY, AFT -
SN/LOT CONTROL CD : S
JRP ASSGN : N

SERIAL/LOT NUM : 1000734
REVISION : *1

ECO : BASIC

DATE: 08/27/93
QTY: 1.00

WOR :

ORIGINATOR : _____

Q.E : _____

OPERATION	WORKCENTER	SET-UP	RUN	DESCRIPTION	BUY POINTS OPS	Q.C.	CUST
9999-00-0	C0023S99	0.00		STORES STOCK PARTS			
9999-00-0			0.00	STORES/PC STOCK PARTS AND RECORD:			

LOC: _____ _____ _____ _____

QTY: _____ _____ _____ _____

TRACE: _____ _____ _____ _____

TRANSACTION INPUT BY: _____ DATE: _____

L[illegible]D
TE[illegible]OLOGIES
CH[illegible]CAL
SYST[illegible]S

SUNNY[illegible]E, CALIFORNIA 94086

MATERIAL HANDLING CARD (MHC)

CSD USE ONLY	
SPECIFICATION NO. N/A	FIGURE A N/A

S[illegible] 1 OF

M[illegible] NO 2550

ITEM IDENTIFICATION DATA	
FED STK NO N/A	NOMENCLATURE BSM Loaded Motor Case-Handling
CONTRACT NO. N/A	CSD P/N (SEE NOTE 2) B12000-01-01
PROGRAM NO. BSM	
PROJECT NO.	

CHARACTERISTICS:

- [X] STURDY
- [ ] [illegible]
- [ ] [illegible]
- [ ] [illegible]
- [ ] [illegible]
- [ ] [illegible]
- [ ] FLAMMABLE
- [ ] LIQUID
- [ ] SOLID
- [ ] COMPRESSED GAS
- [ ] POISON A B C D
- [X] EXPLOSIVE A (B) C

MATERIAL	NET WT. LBS.		
Various	160	L 31 IN	MFG P/N N/A
FINISH Various		W IN	VENDOR P/N N/A
		H IN	
		DIA 13 IN	

PREPARED E.J. Esposito DATE 11 April 84

CHECKED E Esposito DATE 11 April 84

APPROVED [signature] DATE 15 Apr 84

APPROVED

PRESERVATION AND PACKAGING DATA CODED PER MIL-STD-726

1-2 PRESERVATION METHOD	3 QTY UNIT PACK	4 CLN AND DRY	5-6 PRESERVATION MATERIAL	7-8 WRAPPING MATERIAL	9-10 CUSHIONING AND DUNNAGE	11 CUSH THICKNESS	12-13 UNIT PACKAGE	14 INTR CONT QTY	15-16 INTERIM CONTAINER	17 LEVEL OF PROT
										B
										C

MATERIAL SUBSTITUTION PERMITTED

Material must be equal to or better than those specified above, must provide equal or better protection, must not impair function, must be in accordance with current Air Force Bulletin No. 56, meet the requirements of specification MIL-P-116 and be furnished at an equal or lower cost.



434

NOTES

1 MARKING FOR SHIPMENT AND STORAGE PER MIL-STD 129

2 THIS MHC IS APPLICABLE TO ALL DASH NUMBERS

3 Handling and movement of BSM rocket motor cases loaded or un-loaded shall be made on special pallets with cradles and hold-down straps specifically made for this program. This configuration calls for the rocket motor case to placed horizontally on the pallet cradles and secured with the straps which are part of the pallet.

4. Transportation: The pallets containing the rocket motor(s) may be transported using any authorized company vehicle suitable for accomodating the load.

5. Shipping Papers:

Annotate on shipping papers conspicuously the phase,

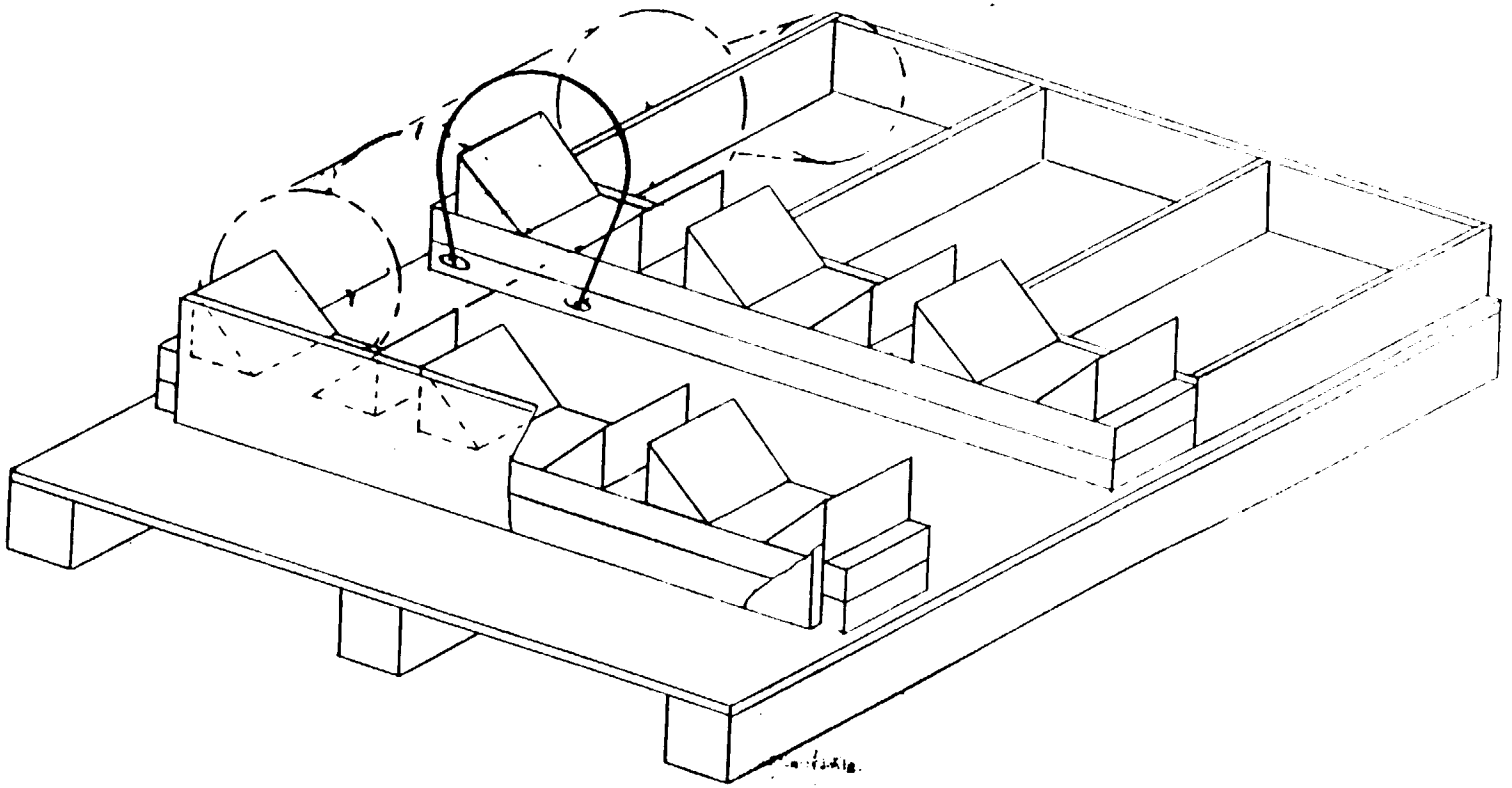
"PROGRAM CRITICAL HARDWARE"

REV. C	Added note 5. Shipping Papers.	5-23-89
Rev. B	Added sht. 2	2/15/87
Rev A	Reasinged new MHC No. 2550 old MHC 2894	

MATERIAL HANDLING CARD SKETCH SHEET

NOMENCLATURE: BSTI LOADED MOTOR CASE HANDLING

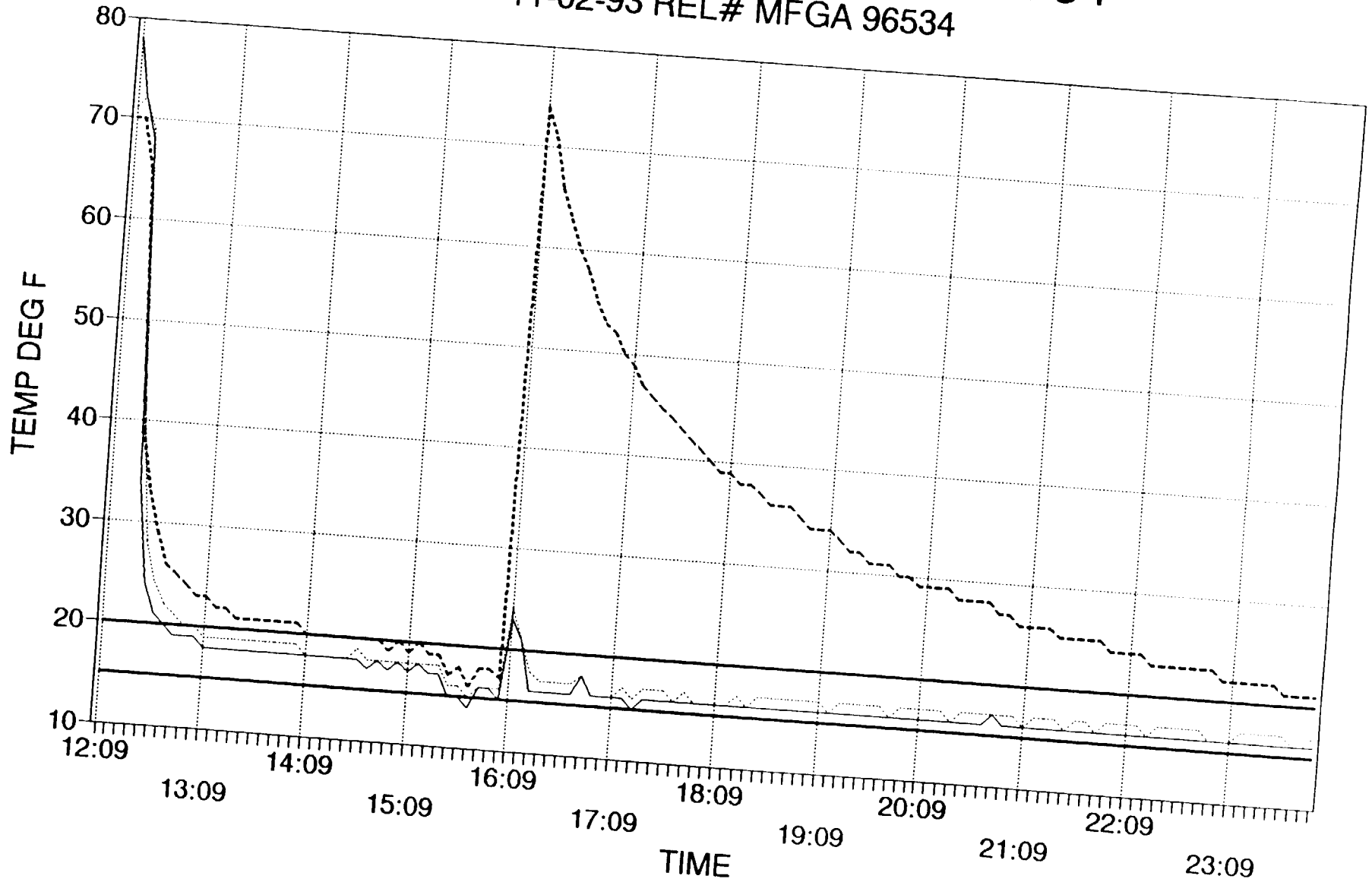
FORM NO. 2550



QTY. REQ'D	DET.	DESCRIPTION

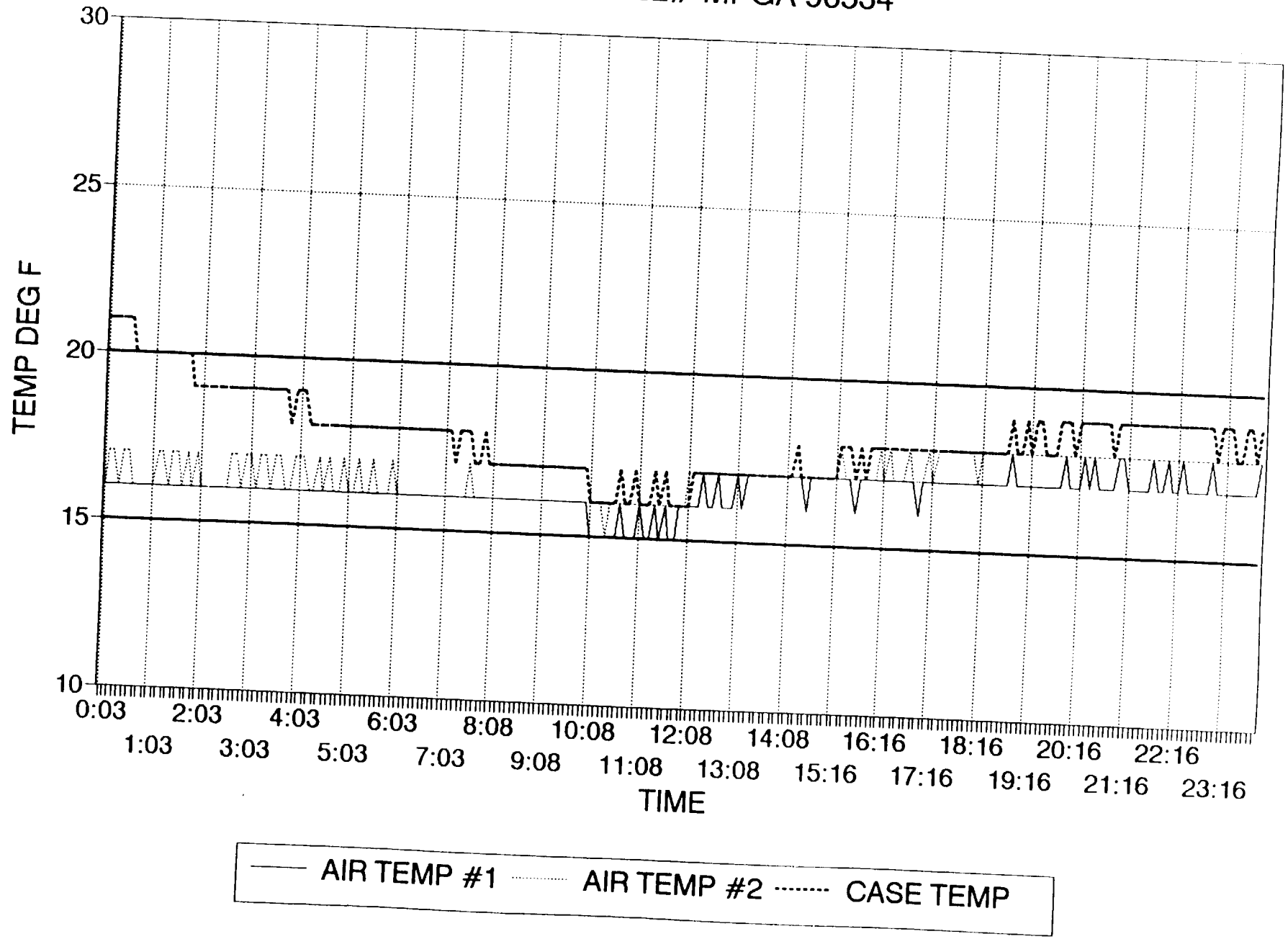
BSM DELTA QUAL S/N 1000734

11-02-93 REL# MFGA 96534



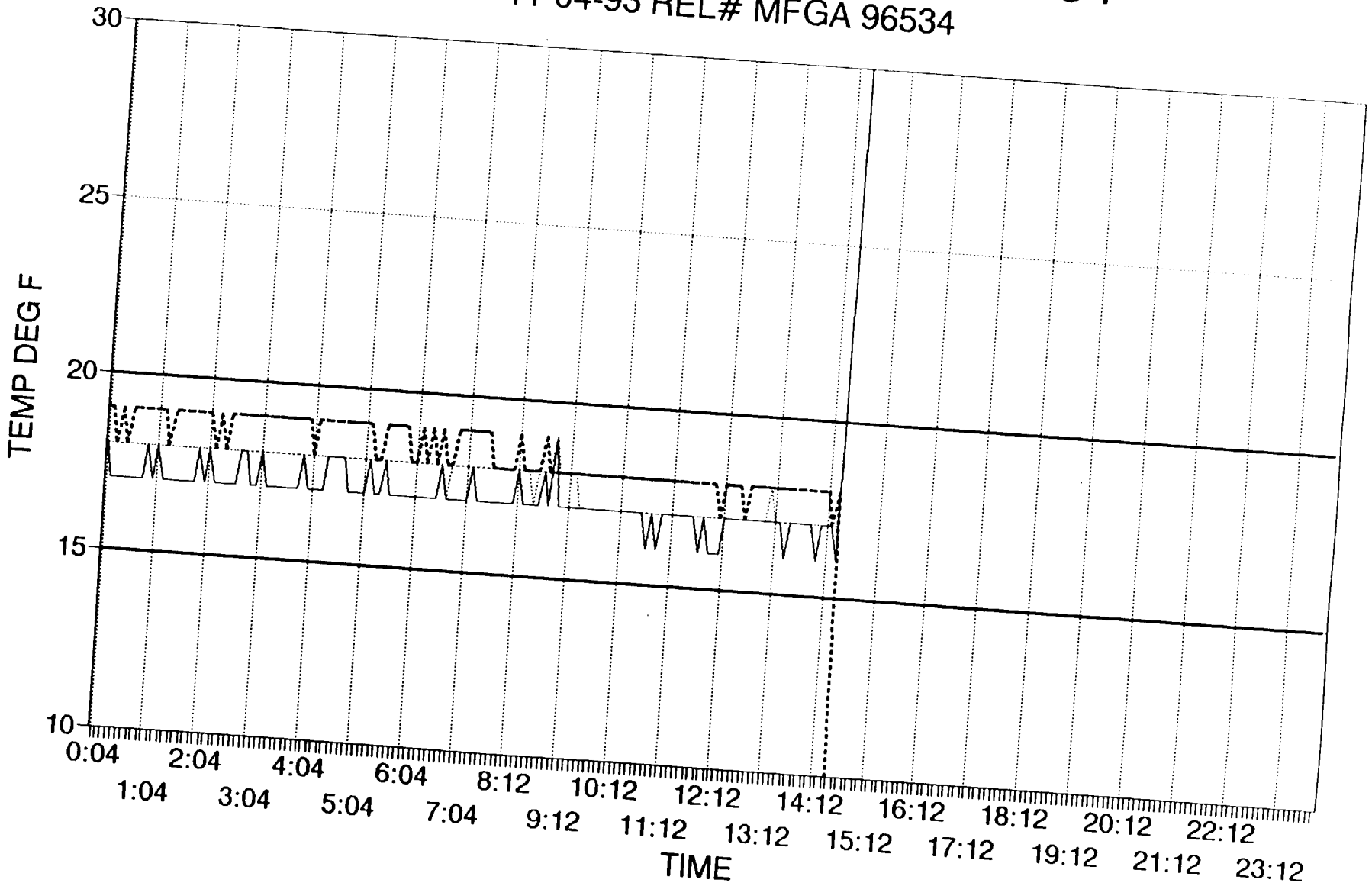
BSM DELTA QUAL S/N 1000734

11-03-93 REL# MFGA 96534



BSM DELTA QUAL S/N 1000734

11-04-93 REL# MFGA 96534

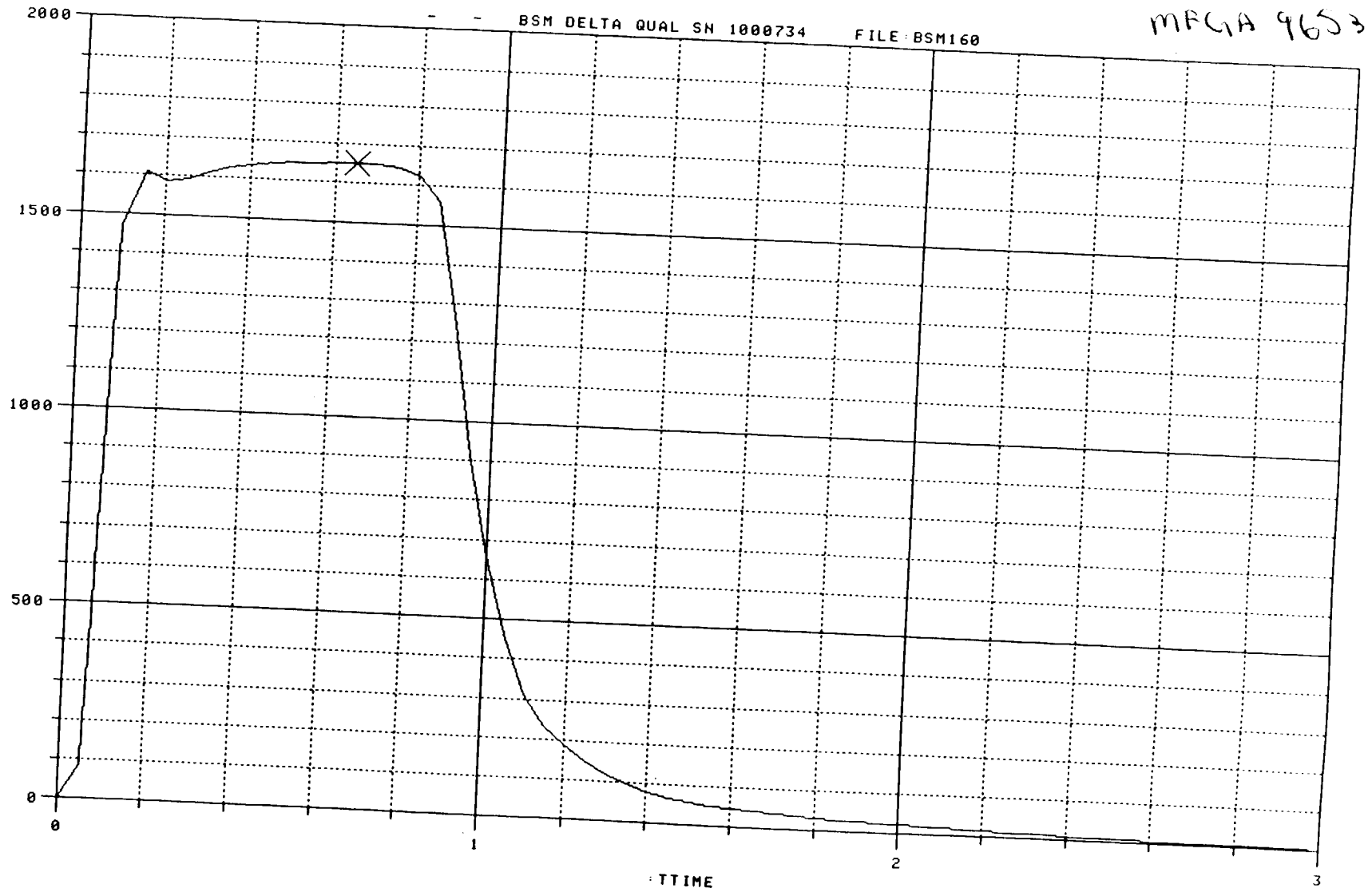


CHEMICAL SYSTEMS DIVISION
ONLINE TEST AREA GRAPHICS SYSTEM

COLD 15°-25°

QUICK LOOK

MFG# 96534



PC-2
439

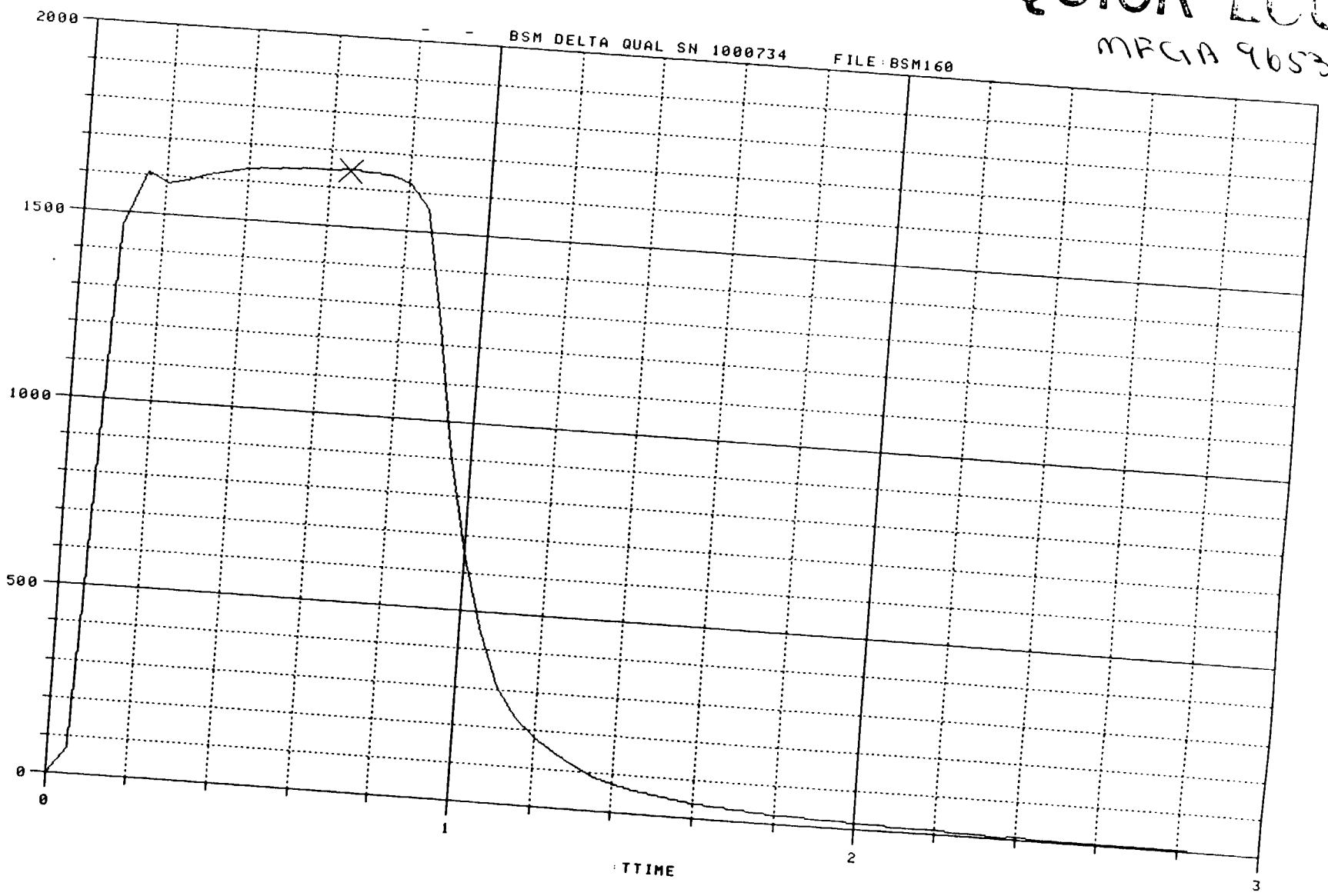
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CHEMICAL SYSTEMS DIVISION
ONLINE TEST AREA GRAPHICS SYSTEM

COLD 15-20°F

QUICK LOOK

MFG# 96534



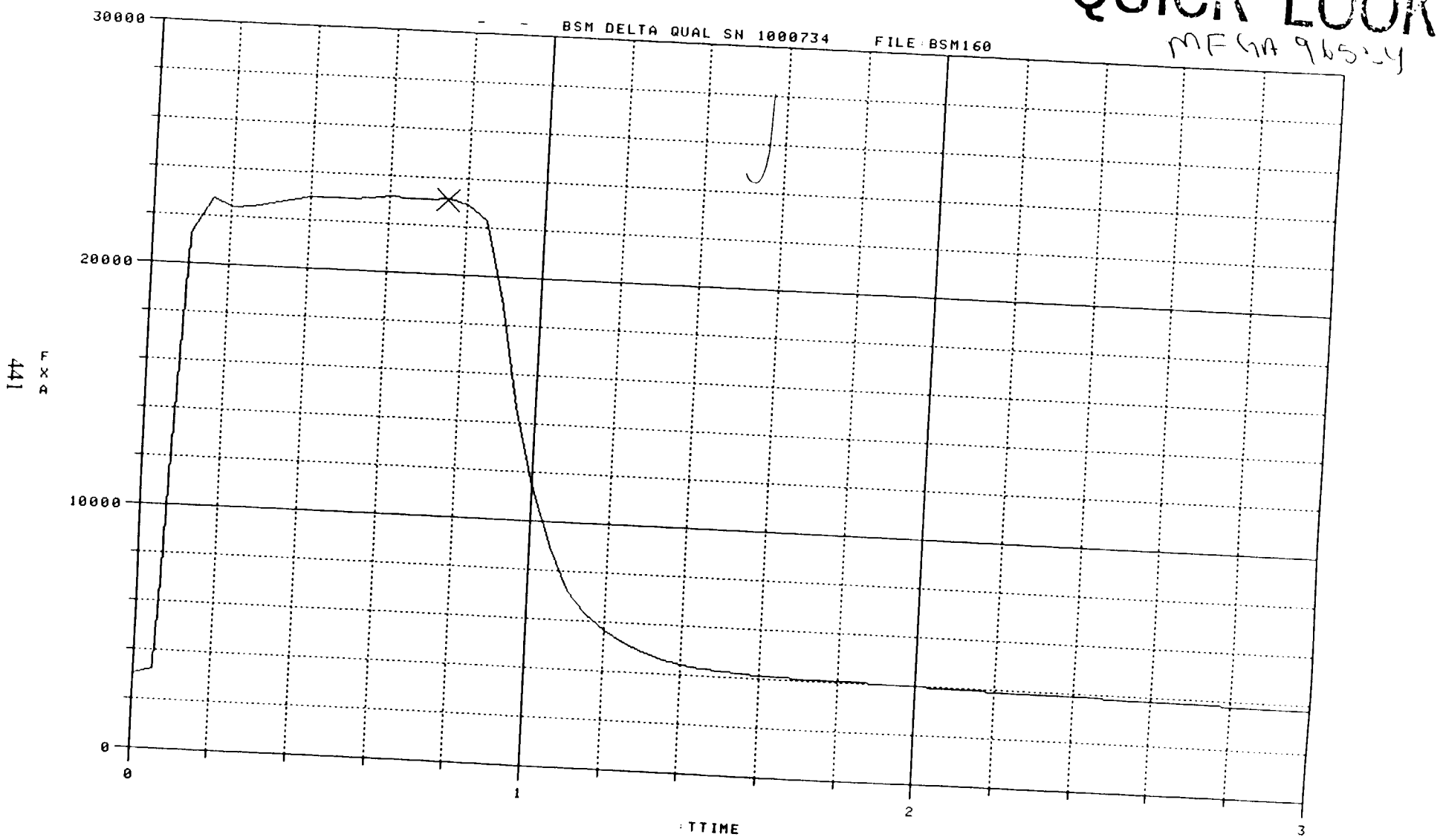
TTIME = 0.659883 PC-1 = 1647.90

CHEMICAL SYSTEMS DIVISION
ONLINE TEST AREA GRAPHICS SYSTEM

COLD IS-2 P

QUICK LOOK

MFHA 965-4



TTIME = 0.750000 FXA = 23117.7

4-NOV-97 15:15:17

CHEMICAL SYSTEMS DIVISION

SDC NUMBER 160-93 TEST LOCATION: ST-3 BNR Pat 9/4/93

TEST ENGINEER: B. R. PATEL INSTRUMENTATION ENGINEER: L. THOMPSON

BAROMETRIC PRESSURE: 29.21 HUMIDITY: 34% AIR TEMPERATURE: 73°

DESCRIPTION: BSM DELTA QUAL SN 1000734 FILE: BSM16093 (WOR 5597-986-00XX)

DATE: 30-AUG-1993 13:03:35

TEST DATE: - -

CHEMICAL SYSTEMS DIVISION

SDC NUMBER 160-93 TEST LOCATION:ST-3
DESCRIPTION:BSM DELTA QUAL SN 1000734

SYSTEM ID:NF-0 SAMPLE RATE: 1000
FILE:BSM16093 (WOR 5597-986-00XX)

DATE: 3-SEP-1993 08:11:47
TEST DATE: - -

PAGE

ITEM	NAME	CLS	ICN NUMBER	DESCRIPTION	EXP MIN	EXP MAX	UNTS	CHN	LO FAC	HI FAC	DIV	PGA GAIN	CAL CODE
1	PC-1	U	A4402520G	CHAMBER PRESSURE #1 (HEAD END)	0.	3000.	PSIA	14	0.	1455.200	200	1	4
2	PC-2	U	A4402522G	CHAMBER PRESSURE #2 (HEAD END)	0.	3000.	PSIA	17	0.	1487.40	200	1	4
3	ES-1A	U		SQUIB VOLTAGE#1A	0.	25.0	VDC	36	0.	20.0	10	2	10
4	IS-1A	U		SQUIB CURRENT#1A	0.	10.0	AMP	38	0.	0.5	10	1	3
5	FXA	U	A4403220S	AXIAL FORCE, A BRIDGE	0.	25000.	LBF	0	0.	25175.0	200	2	6
6	FXB	U	A4403220S	AXIAL FORCE, B BRIDGE	0.	25000.	LBF	1	0.	25180.0	200	2	6
7	FXCA	U	A4403210G	AXIAL FORCE CALIBRATION,A BRIDGE	-25000.	25000.	LBF	2	0.	12472.5	200	2	6
8	FXCB	U	A4403210G	AXIAL FORCE CALIBRATION,A BRIDGE	-25000.	25000.	LBF	3	0.	12495.0	200	2	6
9	FYAA	U	A4403060I	SIDE FORCE AFT IN YAXIS	-1000.0	1000.0	LBF	4	0.	499.45	200	2	6
10	FYFA	U	A4403121I	SIDE FORCE FWD IN YAXIS	-5000.0	5000.0	LBF	5	0.	2500.25	200	2	6
11	FZ1A	U	A4403122I	VERTICAL FORCE AFT IN ZAXIS LEFT	-5000.0	5000.0	LBF	6	0.	2506.75	200	2	6
12	FZ2A	U	A4403122I	VERTICAL FORCE AFT IN ZAXIS	-5000.0	5000.0	LBF	7	0.	2455.75	200	2	6
13	FZ3A	U	A4403122G	VERTICAL FORCE FWD IN ZAXIS	-5000.0	5000.0	LBF	8	0.	2495.0	200	2	6
14	ES-1B	U		SQUIB VOLTAGE#1B	0.	25.0	VDC	37	0.	20.0	10	2	10
15	IS-1B	U		SQUIB CURRENT#1B	0.	10.0	AMP	39	0.	0.5	10	1	3
16	T1	U		EXTERNAL TC FOR QUAL 3.38" AFT	0.	100.	DEGF	48			500	2	12

CHEMICAL SYSTEMS DIVISION

DATE: 30-AUG-1993 13:03:35 PAGE: 3 of

SOC NUMBER 160-93 TEST LOCATION:ST-3 SYSTEM ID:NF-0 SAMPLE RATE: 1000
DESCRIPTION:BSM DELTA QUAL SN 1000734 FILE:BSM16093 (WOR 5597-986-00XX)
TEST DATE: - -

ITEM	NAME	CLS	ICN NUMBER	DESCRIPTION	EXP MIN	EXP MAX	UNTS	CHN	LO FAC	HI FAC	DIV	PGA GAIN	CAL CODE
32	TREF	U	~~A44015008~~ A44015003	REF TEMP	0.	100.	DEGF	63	0.0	~~1.791157~~ 1.79277	10	2	20

867 CSD 11-9-93

867 CSD 11-4-93

CHEMICAL SYSTEMS DIVISION

SDC NUMBER 160-93 TEST LOCATION:ST-3 SYSTEM ID:NF-Ø SAMPLE RATE: 1ØØØ

DESCRIPTION:BSM DELTA QUAL SN 1ØØØ734 FILE:BSM16Ø93 (WOR 5597-986-ØØXX)

DATE: 3-SEP-1993 Ø8:11:47 PAGE: 4 of 2

TEST DATE: - -

ITEM	NAME	CLASS	ICN NUMBER	CABLE	CHAN	MODE CARD	GAIN	DIV	FILTER	AMP CARD	BFR CH	BFR GN	OFFSET	K-FAC SENS	NOTE	11-2-93 INSTALL	11-2-93 END TO END
1	PC-1	U	A4425206	269-ØØ-Ø	14	5Ø2	2ØØ	2ØØ	25Ø	5Ø	Ø1 - .7					867 CSD	
2	PC-2	U	A4425226	269-ØØ-Ø	17	5Ø2	2ØØ	2ØØ	25Ø	5Ø	ØØ - ØØ						
3	ES-1A	U		296-ØØ-Ø	36	5Ø4	1Ø	1Ø	1ØØØ	56	Ø3 - .7						
4	IS-1A	U		296-ØØ-Ø	38	5Ø4	1Ø	1Ø	1ØØØ	56	Ø4 - .7						
5	FXA	U	A4403 2205	269-ØØ-Ø	Ø	5Ø2	2ØØ	2ØØ	25Ø	5Ø	Ø7 - .7					867 CSD	
6	FXB	U	A4403 2205	269-ØØ-Ø	1	5Ø2	2ØØ	2ØØ	25Ø	5Ø	ØØ - ØØ						
7	FXCA	U	A4403 2106	269-ØØ-Ø	2	5Ø2	2ØØ	2ØØ	25Ø	5Ø	Ø8 - .7						
8	FXCB	U	A4403 2106	269-ØØ-Ø	3	5Ø2	2ØØ	2ØØ	25Ø	5Ø	ØØ - ØØ					867 CSD	867 CSD
9	FYAA	U	A4403 0601	269-ØØ-Ø	4	5Ø2	2ØØ	2ØØ	25Ø	5Ø	-						867 CSD
1Ø	FYFA	U	A4403 1211	269-ØØ-Ø	5	5Ø2	2ØØ	2ØØ	25Ø	5Ø	-						867 CSD
11	FZ1A	U	A4403 1221	269-ØØ-Ø	6	5Ø2	2ØØ	2ØØ	25Ø	5Ø	-					867 CSD	867 CSD
12	FZ2A	U	A4403 1222	269-ØØ-Ø	7	5Ø2	2ØØ	2ØØ	25Ø	5Ø	-						867 CSD
13	FZ3A	U	A4403 1220	269-ØØ-Ø	8	5Ø2	2ØØ	2ØØ	25Ø	5Ø	-					867 CSD	867 CSD
14	ES-1B	U		296-ØØ-Ø	37	5Ø4	1Ø	1Ø	1ØØØ	56	Ø5 - .7						867 CSD
15	IS-1B	U		296-ØØ-Ø	39	5Ø4	1Ø	1Ø	1ØØØ	56	Ø6 - .7					867 CSD	
16	T1	U		- -	48	5Ø4	1ØØ	5ØØ	1Ø	5Ø	-						867 CSD

11-2-93 11-2-93

CHEMICAL SYSTEMS DIVISION

SDC NUMBER 160-93 TEST LOCATION:ST-3 SYSTEM ID:NF-0 SAMPLE RATE: 1000 DATE: 30-AUG-1993 13:03:35 PAGE: 5

DESCRIPTION:BSM DELTA QUAL SN 1000734 FILE:BSM16093 (WOR 5597-986-00XX) TEST DATE: - -

ITEM	NAME	CLASS	ICN NUMBER	CABLE	CHAN	MODE CARD	GAIN	DIV	FILTER	AMP CARD	BFR CH	BFR GN	OFFSET	K-FAC SENS	NOTE	INSTALL END TO END
32	TREF	U	~~NKB~~15003	- -	63	508	10	10	30	50	-			79277		867 CSD 11-2-93

CHEMICAL SYSTEMS DIVISION

SDC NUMBER 160-93 TEST LOCATION:ST-3 DATE: 30-AUG-1993 13:03:35 PAGE: 60
DESCRIPTION:BSM DELTA QUAL SN 1000734 SYSTEM ID:WB-1 SAMPLE RATE: 1000 TEST DATE: - -
FILE:BSM16093 (WOR 5597-986-00XX)

ITEM	NAME	CLS	ICN NUMBER	DESCRIPTION	EXP MIN	EXP MAX	UNTS	CHN	LO FAC	HI FAC	DIV	PGA GAIN	CAL CODE
49	PC-1	U	ANA02500C	CHAMBER PRESSURE #1	0	3000	PSIA	14	0	1455.208			
50	ES-1A	U		SQUIB VOLTAGE 1A	0	25	VDC	36	0	20.0			
52	IRIG	U		TIMING IRIG	0	1000	HZ		-	-			

CHEMICAL SYSTEMS DIVISION

SDC NUMBER 160-93 TEST LOCATION:ST-3 SYSTEM ID:WB-1 SAMPLE RATE: 1000 DATE: 30-AUG-1993 13:03:35 PAGE: 7 of

DESCRIPTION:BSM DELTA QUAL SN 1000734 FILE:BSM16093 (WOR 5597-986-00XX) TEST DATE: - -

ITEM	NAME	ICN NUMBER	CABLE	JBOX CH	AMP CH	SIG CDX	SIG CDX GAIN	RCDR TRK/CHN	STEP/SPAN LO	STEP/SPAN HI	OFF SET	K-FAC SENS	NOTE	11-3-93 INSTALL	11-3-93 END TO END
49	PC-1	A9402628C	- -			A-1		01-01	0-000	3-000		1455.208		857 CSD	
50	ES-1A		- -			A-3		03-03	1-000	2-000					
52	IRIG		- -					07-00	-	-					

11-3-53 11-3-53

EM DATA CHART NO. 160-93

CONFIGURATION SECTION

PAGE 8 of 20

TEST DESCRIPTION:	NOTES:
BSM	

BRUSH RECORDER SETUP

NAME	K FACTOR	EXP MIN	EXP MAX	UNITS	CABLE	BRUSH CHANNEL	STEP LO	STEP HI	INSTALL 11-2-93	END-TO-EN 11-2-93
PC1	1479.208 PSIG	0	3000	PSIG		1	0-0.0	3-5.0	867 CSD	867 CSD
ES-1A	20.0 VDC	0	25	VDC		2				
IS-1A	5.0 AMPS	0.0	10.0	AMP		3	1-0.0	2-7.5	867 CSD	
FXA	25175.0 LBS	0	25,000	LBF		4	1-5.0	2-7.5	867 CSD	
FXCA	12472.5 LBS	-25,000	25,000	LBF		7	0-0.0	3-5.0		
ES-1B	20.0 VDC	0.0	25.0	VDC		8	0-5.0	3-7.5	867 CSD	867 CSD
IS-1B	5.0 AMPS	0.0	10.0	AMP		5	1-0.0	2-7.5		
						6	1-5.0	2-7.5	11-2-53	867 CSD 11-2-53

SYSTEM D... CHART NO. 160-93

CONFIGURATION SECTION

PAGE 9 of 20

TEST DESCRIPTION:	NOTES:
BSM	

HANZON DATA LOGGER

NAME	DESCRIPTION	EXP MIN	EXP MAX	UNITS	CABLE	LOGGER CHANNEL	STEP LO	INSTALL	END TO END
								11-2-53	11-2-53
T1	EXTERNAL TC 3.38"	-30	500	DEGF	•	1			
						2			
						3			
						4			

SYSTEM DATA CHART NO. 160-93

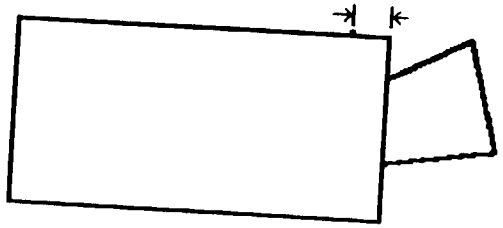
CONFIGURATION SECTION

TEST DESCRIPTION:	NOTES:
BSM	

TC-1

EXTERNAL TC FOR DELTA QUAL

3.38"



MONITOR FOR 5 MINUTES AFTER Tzero

SYSTEM I CHART NO. 160-93 CONFIGURATION SL .ON PAGE 11 of 36

TEST DESCRIPTION:	NOTES:
BSM	

MACSYM 120 SYSTEM DATA CHART

CHAN NUM	LABEL	UNITS	CAL CODE	DIVIDER	LO KFAC	HI KFAC	LIMIT FLAG	LOW LIMIT	HIGH LIMIT	FACILITY FLAG	INSTALL	END TO-END
1	DAT4 / A1	PSIA	4	200				0	3000.0			
2											11-2-93	11-2-93
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												

SYSTEM L CHART NO. 160-93 CONFIGURATION SE. .ON

TEST DESCRIPTION:	NOTES:
BSM	

MACSYM 120 SYSTEM DATA CHART

CHAN NUM	LABEL	UNITS	CAL CODE	DIVIDER	LO KFAC	HI KFAC	LIMIT FLAG	LOW LIMIT	HIGH LIMIT	FACILITY FLAG	INSTALL	END TO-END
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												

SYSTEM D CHART NO. 160-93 CONFIGURATION SE JN

TEST DESCRIPTION:	NOTES:
BSM	

MACSYM 120 SYSTEM DATA CHART
HANDWIRED CHANNELS

CHAN NUM	LABEL	UNITS	FIRELINE CONSTANT	MULTIPLIER	LIMIT FLAG	LOW LIMIT	HIGH LIMIT	FAC. FLAG
25	ES1A	VDC	1.809	-5.0				
26	ES1B	VDC	1.766	-5.0				
27								
28								
29								
30								
31	E+	VDC		5.03				
32	ORD	VDC		-4.74		22.0 20.0 ~~24.0~~	27.0 30.0	

REV CCN ~~160-93-3~~ 160-93-4 867 CSD 11-3-93

867 CSD 11-3-93

SYSTEM DATA CHART NO. 160-93

CONFIGURATION SECTION

TEST DESCRIPTION:	NOTES:
BSM	

MACSYM 120 SYSTEM DATA CHART, DAT4 PRESSURE TRACE PC-1

TIME	UPPER LIMIT	LOWER LIMIT	XMIN/ XMAX	YMIN/ YMAX
			0	0
			10	3000

TEST ENGINEER _____

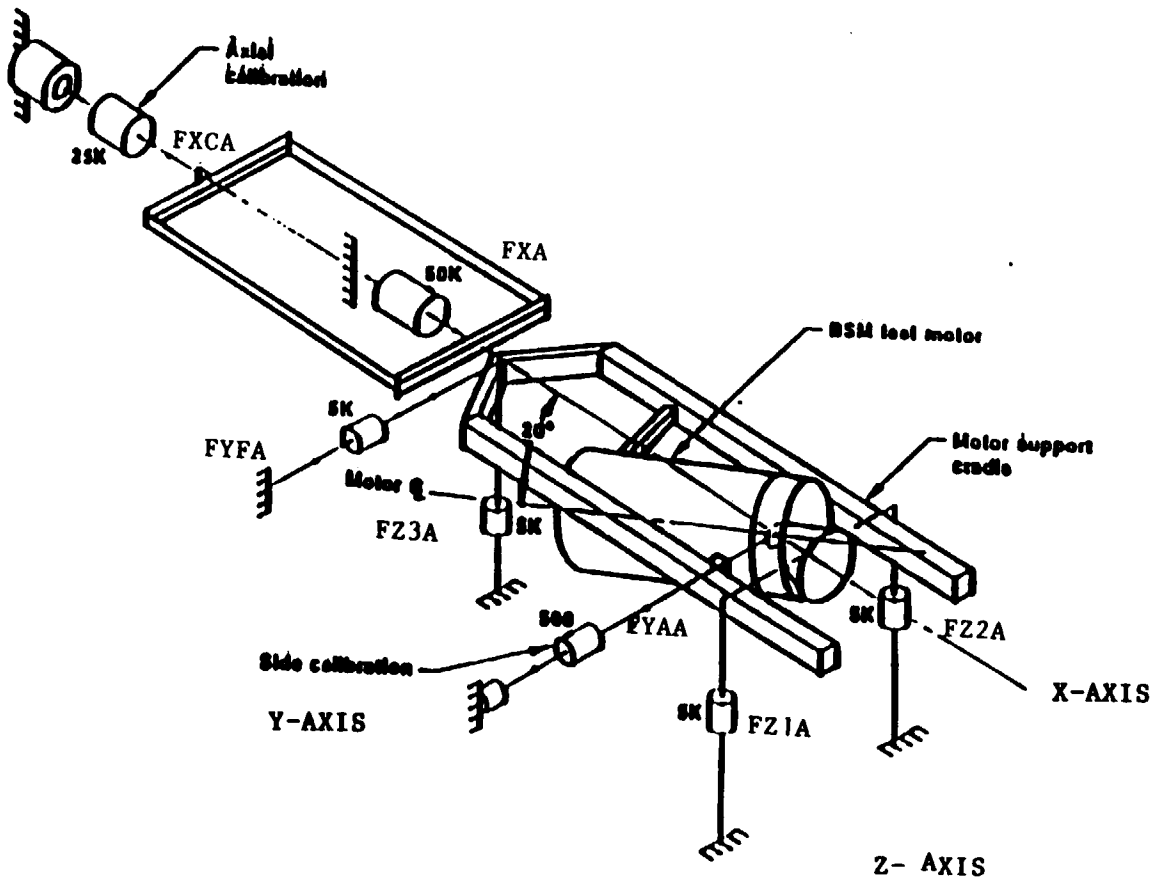
**See Test Engineer for K Factor

SY DATA CHART NO. 160-93

CONFIGU JN SECTION

TEST DESCRIPTION:	NOTES:
BSM	

BSM THRUST MOUNT



TEST DESCRIPTION:	NOTES:
BSM	

1. **STRAIN GAGES:**
   Adjust exitation to 5.0 + 0.0/-.1 VDC. Adjust Balance if output is greater than +/- 2000 counts.

2. **PRESS - LOAD CELLS**
   Adjust exitation to 10.0 + 0.0/- .1VDC. Adjust Balance if output is greater than +/- 2000 counts, (Load Cells only using 509 mode card).

3 **PRESS - LOAD**
   Facility type or call with load adjust exitation to 10.0 +0.0/-.1 VDC.

4. **POTS**
   Adjust exitation to 1.0 +0.0/-.1 VDC.

5. Perform end to end checks.

6. Referance configuration patching sheet for parrallel Patching.

7. **KISTLER/ PCB XDUCER**
   Set crystal amp gain to 30.0, HI FACT = K-FACT x 30, DC mode.

8. Conversion of this data to engineering units is based on factors supplied by others. Therefore data traceability to N.B.S. cannot be assured.

9. Run type K extension wire from T/C ext box to T-strip on motor case and connect T/C to T-strip.

10. Check T-Ref Peritek Temp by comparing it to a hand-held T/C meter.

TEST DESCRIPTION:	NOTES:
BSM	

A. Hook up instrumentation to T-strips.

B. Stamp off Installed section on SDC.

C. Hook up instrumentation to J-Boxes.

D. Adjust Exitation per SDC requirements:
If unspecified:

Strain gages	= 5 + 0.0/-.1 VDC
Pressure/Force	= 10 +/- . 1 VDC
Pots	= 1 + 0.0/-.1 VDC

E. Adjust Balance per SDC requirements:
If unspecified +/- 2000 counts.

F. Verify voltage calibrator output = 5.0 +/- .005 VDC

G. Perform end to end checks.

H. Enter K factors on SDC as follows:

a. Press, Force Pots -

Lo Factor	- Enter 0.0
Hi Factor	- Enter K factor on firing card
Cal Load Cell	- Tension K Factor
Axial Load Cell	- Comp. K Factor
Side Force Load Cell	- Avg. Tension & Compression

I. Run Caltabout on the NEFF system.

NOTE:

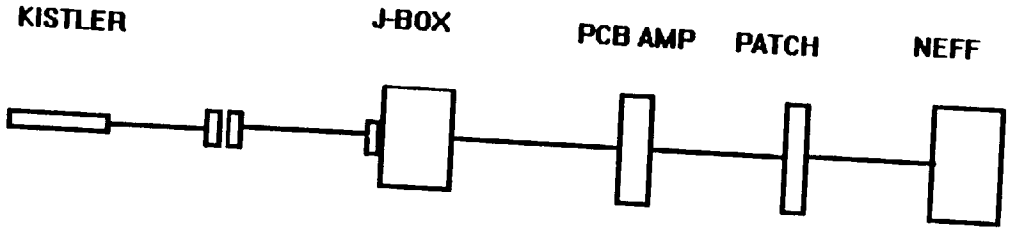
CAL 1 = Zero adj. +/- 165 counts (adjust at 100 box)

$$\text{CAL 2} = \frac{[4.9 * \text{PGA} * \text{CGAIN}]}{[305.2 \times 10\text{-}6 \text{ volt/CNT}]} = +/-.5\% +/-165 \text{ cnts}$$

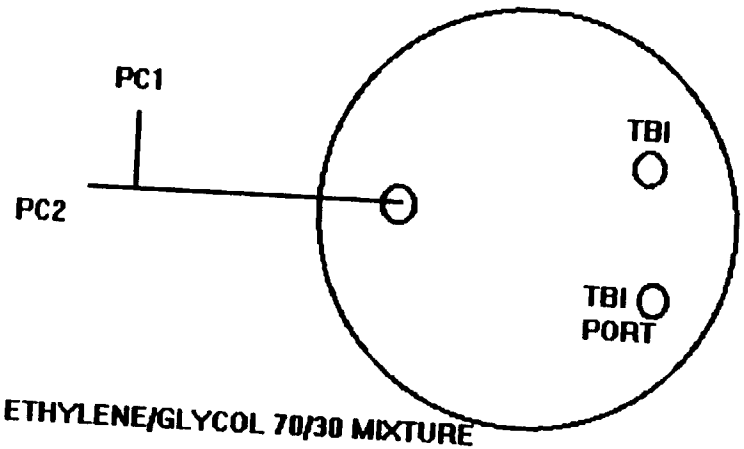
J. Perform physical inspection of connectors and bay safety, clean and replace as necessary.

TEM DATA CHART NO. 160 - 93 CONFIGURATION SECTION PAGE 18 of 20

TEST DESCRIPTION:	NOTES:
BSM	

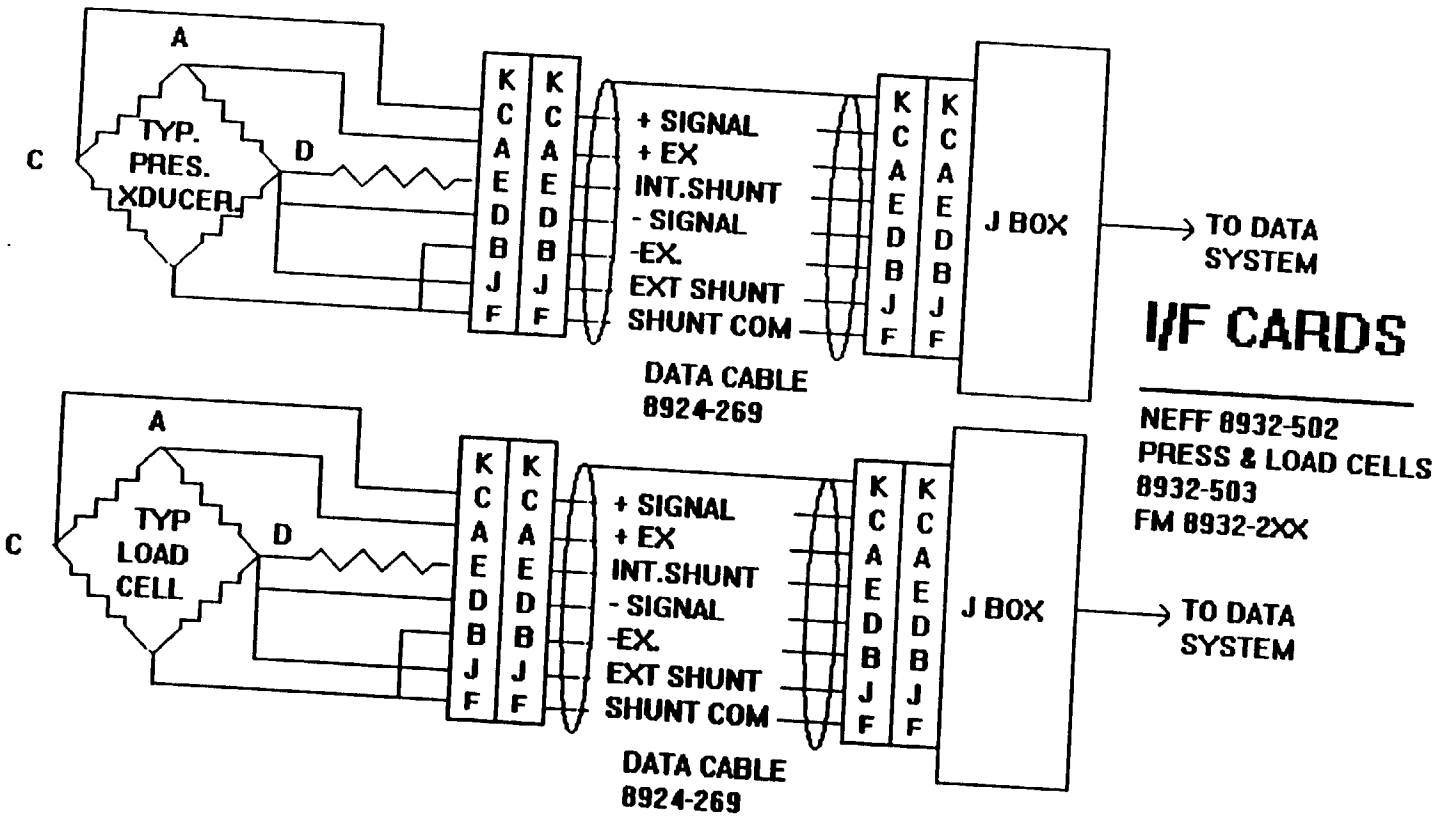


AMP 484B10 IN (DC) MODE GAIN=1 AMP=6 (IF APPLICABLE)



ETHYLENE/GLYCOL 70/30 MIXTURE

TEST DESCRIPTION:	NOTES:
BSM	



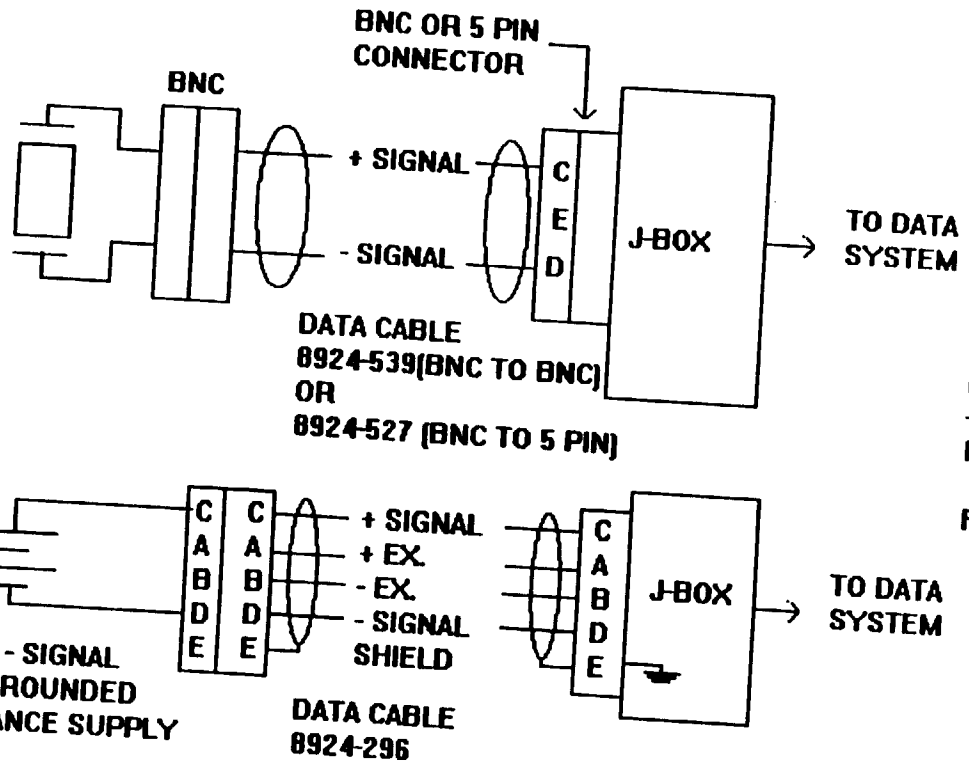
I/F CARDS

NEFF 8932-502
PRESS & LOAD CELLS
8932-503
FM 8932-2XX

TEM DATA CHART NO. 166-93

CONFIG. ION SECTION

TEST DESCRIPTION:	NOTES:
BSM	



I/F CARDS FOR CRYSTAL XDUCERS

NEFF 8932-504
FM 8932-39X

I/F CARDS FOR VOLTAGE MEASUREMENTS

NEFF - 8932-504 (5MV - 10V)
8932-509 (10V - 100V)
FM - 8932-3XX

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DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (FORWARD)	REL. #: MIGA 96533	PAGE 6 OF 18
	PART #: B12000-13-01-501	DAR REV: BASIC

ITEM CAT ZONE METHODS CODE SOURCE / INSPECTION INSTRUCTIONS	DATA MANAGEMENT			FINAL ACCEPTANCE		
	DESIGN LIMITS		DATA RECORDING	OPER	QUALITY	CUST/GOV
	MIN.	MAX.		STP-DT	STP-DT	STP-DT

PD001 III --- VIS REC C1

RECORD TORQUE OF GROUND STRAP TO CONTAINER. (N/A IF GROUND STRAP PREVIOUSLY INSTALLED.) 45 IN-LB 55 IN-LB WRENCH S/N: _____ TORQUE: _____ IN-LB

N/A P 141 C S

T 9/3/93

PD002 I --- VIS VER C1,P1

MOTOR CONDITION IS ACCEPTABLE. QUALITY CONTROL, GOVERNMENT QUALITY ASSURANCE, AND USBI INSPECT. ACCEPTABLE

116 C80 9/3/93

GOV'T 9/3/93

USBI 9/3/93

GOV'T 9/3/93

PD003 I --- VIS VER C1,P1

Q.C. VERIFY SECURITY BAG AND LEAD SEAL IS PROPERLY SECURED. GOV'T VERIFY.

PD004 IIM --- VIS VER C1

VERIFICATION OF HUMIDITY INDICATOR AND RELIEF VALVE IS TIGHT.

PD005 IIC --- VIS VER C1

RECORD TORQUE OF GROUND STRAP TO MOTOR. 50 IN-LB 55 IN-LB WRENCH S/N: 31100/682 TORQUE: 50 IN-LB

P 67 C S 9/3/93

T 9/3/93

DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (FORWARD)

REL. #: MFGA 96533 | PAGE 7 OF 18

PART #: B12000-13-01-501 | DAR REV: BASIC

ITEM CAT ZONE METHODS CODE SOURCE / INSPECTION INSTRUCTIONS	DATA MANAGEMENT: DESIGN LIMITS MIN.	DESIGN LIMITS MAX.	DATA RECORDING	FINAL ACCEPTANCE: OPER STP-DT	QUALITY STP-DT	CUST/GOV STP-DT
PD006 IIC --- VIS REC C1 RECORD TORQUE OF TIE-RODS.	20 IN-LB	22 IN-LB	WRENCH S/N: J1100 1705 TORQUE: 21 IN-LB	318 C S T 9-3-93		
PD007 IIM --- VIS VER C1 INSTALLATION OF (12) DESICCANT BAGS.	16	---	ACCEPTABLE			
PD008 IIC --- VIS VER C1 RECORD TORQUE OF LOCKRING.	66 IN-LB	78 IN-LB	WRENCH S/N: J1100/682 TORQUE: 70 IN-LB	P 67 C S 9-3-93		
PD009 IIM --- VIS VER C1,P1 VERIFICATION OF HUMIDITY INDICATOR. GOV'T VERIFY.	---	40%	ACCEPTABLE	318 C S T 9-3-93		
PD010 IIM --- VIS VER C1 INSTALLATION OF Q.C. SEAL. USBI INSPECT.			ACCEPTABLE	116 C S 9-3-93	GOVT 9-3-93	USBI 9-3-93
PC001 IV --- VIS VER C2 PALLETS PROPERLY LABELED. PALLET LIST FORWARDED TO ENGINEER.	---	---	ACCEPTABLE	P 141 C S 9/3/93		

DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

PCS 040217 PG 5 OF 5

TITLE: BSM ENVIRONMENTAL ROCKET MOTOR UNPACKAGE (FORWARD)	Q.E. APPROVAL	DATE	REL NO. MFGA 96533	PAGE 8A OF 18
			PART NO. B12000-13-01-501	DAR REV. BASIC

ITEM	CAT	ZONE	METHODS	CODE	SOURCE	INSPECTION INSTRUCTIONS	DATA MANAGEMENT: DESIGN LIMITS MINIMUM	DESIGN LIMITS MAXIMUM	DATA RECORDING	FINAL ACCEPTANCE: OPERATOR STP-DATE	QUALITY STP-DATE	CUST/GOVT STP-DATE
PD001	III	-	VIS	VER	C2	Q.C. VISUAL INSPECT CONTAINER FOR DAMAGE. USBI VISUALLY INSPECT.	---	---	See comment sheet Item 1A		USBI 680 OCT 07 1993	OCT 07 1993
PD002	III	-	VIS	REC	C1	Q.C. VERIFY MOTOR AND CONTAINER S/N ARE THE SAME (N/A LINES NOT USED).	---	---	MOTOR S/N 1000738 N/A	CONTAINER S/N 1000738 N/A		293 CSD OCT 07 1993
PD003	III	-	VIS	VER	C2,G2	Q.C. VISUAL INSPECT MOTOR FOR DAMAGE. AFQC & USBI WITNESS. NCR D12391 See PCS 040217			SEE COMMENT SHEET, ITEM # 3A Less NCR D12391 SEE COMMENT SHEET, ITEM # 5		AFQC 10-22-13 USBI 680 OCT 07 1993	293 CSD OCT 07 1993 10-22-13 AFQC 10-25-93 USBI BPC 408 10/25/93

SEE COMMENT SHEET, ITEM # 6

DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (FORWARD)	REL. #: MFGA 96533	PAGE 8 OF 18
	PART #: B12000-13-01-501	DAR REV: BASIC

ITEM CAT ZONE METHODS CODE SOURCE / INSPECTION INSTRUCTIONS	DATA MANAGEMENT: DESIGN LIMITS MIN. MAX.	DATA RECORDING	FINAL ACCEPTANCE: OPER STP-DT	QUALITY STP-DT	CUST/GOV STP-DT

PD011 IIC --- VIS VER G2

GOV'T. VERIFY PALLETIZATION OF MOTORS AND INSTALLATION INTO VEHICLE.

ACCEPTABLE

GOVT 9-3-93

PD012 IIM --- VIS VER C2,G2

Q.C. AND GOV'T FINAL INSPECTION OF TRANSPORTATION CONDITION.

ACCEPTABLE

116 CSO 9-3-93 GOVT 9-3-93

D014 III --- VIS REC C1

RECORD RESULTS OF VISUAL INSPECTION. NO ANOMALIES

GOVT INSPECT MOUNTING & AEROHEAT SHIELD HOLES (PCS 040223)

see comment sheet

Item 5 + NCR D12391

Item 1 thru 4 less NCR D12391

293 CSO 10-22-93 USBI BPC 406 OCT 07 1993 10/25/93

D015 II NOTE 7 VER C2

ALCOHOL WIPE WITNESS

ACCEPTABLE

USBI 66 CS 10-12-93 USBI 680 10-12-93

GOVT 10-12-93

NCR D12391
Items 5 + 6

GOVT

Nondestructive Inspection
Alcohol Liquid Penetrant
Visual Examination Data Sheet

WORK INSTRUCTION/TECHNIQUE: 60.12.9-420-003	REVISION: 2	WORK ORDER NUMBER: 5597-986-0000
CLEANER USED (IF REQUIRED): NONE	BATCH NO.: NONE	DRYING TIME: NONE
ALCOHOL TYPE: ISOPROPYL	BATCH NO.: 2576	DWELL TIME: 5 SECONDS
ACCEPTANCE CRITERIA: DRAWING NOTE 7		
REFERENCE NCR NO. (IF APPLICABLE): NONE	PLANNING NO./NCR NO.: MFGA 96533	
DRAWING NO./PART NO.: ~~B12003-~~ ~~-01~~ B12000-1301-501	ITEM DESCRIPTION: BSM NOZZLE ASSY. (GRAPHITE THROAT)	

260 CSD 10-12-93

ITEM IDENTIFICATION SERIAL NUMBER	INDICATION DESCRIPTION/REMARKS	VISUAL	LIQUID PENETRANT	ACCEPT
4,000,738	NO INDICATIONS NOTED	X	X	X

SKETCH

INSPECTOR Michael Fuchs LEVEL ~~II~~ II DATE 10-12-93

CSD 2732 (92/06)

DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (FORWARD)	REL. #: MFGA 96533	PAGE 9 OF 18
	PART #: B12000-13-01-501	DAR REV: BASIC

ITEM	CAT	ZONE	METHODS	CODE	SOURCE	INSPECTION INSTRUCTIONS	DATA MANAGEMENT			FINAL ACCEPTANCE		
							DESIGN LIMITS MIN.	DESIGN LIMITS MAX.	DATA RECORDING	OPER STP-DT	QUALITY STP-DT	CUST/GOV STP-DT
D016	III		VIS	REC	C1	SE0727 (PCS 040223) (3.10.3) RADIOGRAPHIC INSPECTION.			X-RAY COMPLETED MOTOR ACCEPTABLE			
PC002	III		SMI	VER	C3	MOTOR INTERIOR INSPECTION AND INSPECT WEATHER SEAL INSTALLATION. (PCS 41834)			NO DAMAGE			
PC003	III		-	VIS	REC	C3 MOTOR SERIAL NUMBER, SYSTEM DATA CHART.	---	---	S/N: 1000738 SDC: ~~100-93~~ 161-93			

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USBI 680 10-13-93

GOVT 13 OCT 93

USBI 10-25-93

293 CSD OCT 25 1993

VOID ML 10-14-93

293 CSD OCT 14 1993

SEE CONTINUATION SHEET, ITEM # 7

GOVT 10-25-93

867 CSD 11-2-93

867 CSD 11-2-93

UNITED TECHNOLOGIES

Radiograph
Inspection R

PART NUMBER	REV. ECO'S	PROJECT	NDT LAB CONTROL NO.
B12000-13-01-501	#1 NONE	5597	93100767

PART/MATERIAL NAME: BSM DELTA QUAL MOTOR TEST (FORWARD)

SPECIFICATION: SE0727

PROCEDURE/PLAN NO: Ref MFGA 96533

NCR NO: NONE

QUANTITY			
RECEIVED	INSPECTED	ACCEPTED	REJECT
1	1	1	-0-

SERIAL NO./VIEW	ACC.	REJ.	REMARKS/DESCRIPTION
1000738			
0°	X		NO INDICATIONS NOTED
45°	X		
90°	X		
135°	X		

TECHNIQUE

Work/instruction No. 60.129-277

(or fill in below)

EQUIPMENT

KV/MEV

MA/RADS

TIME

FFD

MATERIAL THICKNESS

VIEWS

PENETRAMETER

PENETRAMETER BLOCK

FILM TYPE

SCREENS

CASSETTES

DENSITY

SENSITIVITY

DEVELOPMENT

FILM USED

SKETCH OR PHOTO

INTERPRETER: S. Hd

DATE: 10/13/93

CSD 1430C (89/07)

DISTRIBUTION: WHITE — WITH O&QR CANARY - [illegible] PINK — FILE

PAGE 1 OF 1

DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (FORWARD)	REL. #: MFGA 96533	PAGE 10 OF 18
	PART #: B12000-13-01-501	DAR REV: BASIC

ITEM CAT ZONE METHODS CODE SOURCE INSPECTION INSTRUCTIONS	DATA MANAGEMENT			FINAL ACCEPTANCE		
	DESIGN LIMITS		DATA RECORDING	OPER	QUALITY	CUST/GOV
	MIN.	MAX.		STP-DT	STP-DT	STP-DT

PC004 III TABLE II SMI VER C1

PRE-TEST AND POST-TEST MEASUREMENTS

			PRE-TEST	POST-TEST
1.	FINAL ASSEMBLY WEIGHT	(INC.CDF)	159.0 165	81.0 LBS
2.	THROAT DIAMETER, IN. (FOUR EQUALLY SPACED MEASUREMENTS)	0°	3.137	3.140
		45°	3.136	3.138
		90°	3.136	3.140
		135°	3.136	3.133
3.	EXIT DIAMETER, IN. (FOUR EQUALLY SPACED MEASUREMENTS)	0°	7.551	7.528
		45°	7.551	7.527
		90°	7.552	7.533
		135°	7.549	7.535
4.	BAROMETRIC PRESSURE, IN.HG.		29.24	29.24
5.	RELATIVE HUMIDITY, %		35 %	35 %
6.	AMBIENT TEMPERATURE, °F		71°	71°

CSD/QC STP/DT PRE-TEST | CSD/QC STP/DT POST-TEST | CSD/QC STP/DT PRE-TEST | CSD/QC STP/DT POST-TEST | USBI

1 11/2/93 | 11/2/93 | 11-5-93 | 11/2/93 | 11/2/93 | 11-5-93

2 11/2/93 | 11/2/93 | 11-5-93 | 11/2/93 | 11/2/93 | 11-5-93

3 11/2/93 | 11/2/93 | 11-5-93 | 11/2/93 | 11/2/93 | 11/2/93

4 10% 11-5-93 | 11/2/93 | 11/2/93 | 11-5-93

5 105 11-5-93 | 11/2/93 | 105 11/2/93

6 11-5-93 | 11/2/93 | 11-5-93 | 11/2/93 | 11/2/93

T 11/2/93

D017 III VIS VER C2

TORQUE DATA FOR TBI(S) AND/OR ADAPTER INSTALLATION. 325 IN-LB 375 IN-LB WRENCH S/N: J11D0140

TORQUE: 350 IN-LB

DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (FORWARD)	REL. #: MFGA 96533	PAGE 11 OF 18
	PART #: B12000-13-01-501	DAR REV: BASIC

ITEM CAT ZONE METHODS CODE SOURCE / INSPECTION INSTRUCTIONS	DATA MANAGEMENT				
	DESIGN LIMITS		DATA RECORDING	FINAL ACCEPTANCE		
	MIN.	MAX.		OPER	QUALITY	CUST/GOV
				STP-DT	STP-DT	STP-DT

PD013 III SE0837 SMI REC
FIG. 1

INSTALLATION OF LUBRICATED AS568A-904 O-RING, AND RECORD TORQUE OF AN815-4S UNION INTO PRESSURE PORT.

50 IN-LB 60 IN-LB WRENCH S/N: J1100 11 85

TORQUE: 60 IN-LB

T 11/2/93

D018

COMPLETION OF INSTRUMENTATION.

USBI

867 CSD 11-2-93 | 105 11-2-93 | USBI 680

PD014 III SE0837 VIS REC C1,G1
4.2.3.2

STABILIZATION AND CONDITIONING.

15°F or 130°F — 20°F or 135°F

TEMP: 130 °F

TIME: 22.46

DATE: 11-02-93

123 CSD 11-2-93 | 105 11-2-93

PC005 III — VIS VER C1,P1

COMPLETION OF CST.

— — ACCEPTABLE

USBI

123 CSD 11/4/93 | 105 11-4-93 | USBI 680 11-4-93

D019 III SE0837 VIS VER C2
4.2.3.2

MOTOR CONDITIONING.

15°F or 130°F — 20°F or 135°F

TEMP: 134 °F

TIME: 36 Hrs. 46 min.

DATE: 11/4/93

123 CSD 11/4/93

24 HR — ACCEPTABLE

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DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (FORWARD)	REL. #: MFGA 96533	PAGE 12 OF 18
	PART #: B12000-13-01-501	DAR REV: BASIC

ITEM CAT ZONE METHODS CODE SOURCE / INSPECTION INSTRUCTIONS	DATA MANAGEMENT: DESIGN LIMITS MIN.	MAX.	DATA RECORDING	FINAL ACCEPTANCE: OPER STP-DT	QUALITY STP-DT	CUST/GOV STP-DT
D020 III SE0837 4.2.3.2 VIS REC C1						
REMOVAL OF MOTOR FROM CONDITIONING.	---		TIME: 11:32			
			DATE: 11-04-93			
TOTAL CONDITIONING TIME. GOV'T VERIFY.	24 HR	---	TOTAL 36 HR. 46 MIN HOURS			
D021 III SE0837 4.2.3.2 VIS REC C2						
FIRING. PCS 41841			TIME: 12:08	ENGR		
			DATE: 11/4/93			
RECORD TOTAL TIME OUT OF CONDITIONING. Q.C. VERIFY ~~30 MIN. MAXIMUM OUT OF CONDITIONING IS MET~~.	---	~~30 MIN~~	OUT: 36 MIN			
Record motor ~~Case~~ Temp MPBT (Plotted)	125°F	130°F	129.5 °F			
Record ambient Temp	—	—	71 °F			

(PCS 040223)

Larry Murphy BSM Proj. Engr 11/4/93

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DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (FORWARD)	REL. #: MFGA 96533	PAGE 13 OF 18
	PART #: B12000-13-01-501	DAR REV: BASIC

ITEM CAT ZONE METHODS CODE SOURCE / INSPECTION INSTRUCTIONS	DATA MANAGEMENT: DESIGN LIMITS MIN.	DESIGN LIMITS MAX.	DATA RECORDING	FINAL ACCEPTANCE: OPER STP-DT	QUALITY STP-DT	CUST/GOV STP-DT

PD015 III BDN-371-90 VIS REC C2

STATUS OF BLASTING CAP(S).

STATUS OF CDF(S).

STATUS OF TBI(S).

P/N AND S/N OF ANY COMPONENT THAT DID NOT FIRE. (RECORD "N/A" IF ALL COMPONENTS FIRED.)

CAP(S) FIRED Fired

CDF(S) FIRED Fired

TBI(S) FIRED Fired

11/4/93 (CSD 23) 11-4-93 (105) USBI (680) 11-4-93

BLASTING CAP(S): P/N: N/A
S/N: N/A 11-5-93

CDF(S): P/N: N/A
S/N: N/A

TBI(S): P/N: N/A
S/N: N/A 105 11-5-93

PC006 III --- VIS VER C2

TEST COMPLETION.

--- --- VERIFY ENGR (CSD 23) 11/4/93 (105) USBI (680)

PD016 III BDN371-90 VIS REC C2

TBI(S) AND IGNITER S/N(S).

--- --- TBI S/N: 2930

TBI S/N: 2935

IGNITER: 5569 (CSD 23) 11-4-93

(105) 11-4-93

(PS 040223)

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DATA ACCEPTANCE RECORD

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

TITLE: BSM DELTA QUAL MOTOR TEST (FORWARD)	REL. #: MFGA 96533	PAGE 14 OF 18
	PART #: B12000-13-01-501	DAR REV: BASIC

ITEM CAT ZONE METHODS CODE SOURCE / INSPECTION INSTRUCTIONS	DATA MANAGEMENT: DESIGN LIMITS MIN. MAX.	DATA RECORDING	FINAL ACCEPTANCE: OPER STP-DT	QUALITY STP-DT	CUST/GOV STP-DT

PD017 III TABLE II SMI VER C1

IGNITER WEIGHT.

--- ---

SEE COMMENT SHEET, ITEM # 8

WEIGHT: 5.205 lbs

P 141 CVS NOV 09 1993 11-9-93

PD018 III BDN371-90 VIS REC C2

CASE OF NOZZLE S/N(S)

--- ---

CASE S/N: 1000738/IO 511

NOZZLE S/N: W0442

P 141 CVS NOV 09 1993

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PD019 III TABLE II SMI VER C1

NOZZLE WEIGHT, THROAT AND EXIT CONE DIAMETERS. USBI WITNESS. GOVT WITNESS (PCS 040223)

--- ---

NOZZLE WEIGHT: 29.150 lbs

P 141 CVS 293 USBI BPC NOV 09 1993

THROAT DIAMETERS:

45° 3.138"
90° 3.137"
180° 3.141"
~~270°~~ 135 3.137"

NOV 09 1993 GOVT NOV 09 1993

EXIT DIAMETERS:

45° 7.523"
90° 7.531"
180° 7.524"
~~270°~~ 135 7.530"

SEE COMMENT SHEET, ITEM # 8

SEE COMMENT SHEET, ITEM # 9

E001 III T.P. VIS REC C1

ENGINEER COMPLETE THE FOLLOWING INSPECTION PLAN.

GOVT INSPECT TBI'S, IGNITER, IGNITER BOND LINES, AND MOTOR INTERIOR. (PCS 040223)

ENGINEER 4/9/93

ENGR USBI

GOVT

TITLE: BSM DELTA QUAL MOTOR TEST (FORWARD)	REL. #: MFGA 96533	PAGE 15 OF 18
	PART #: B12000-13-01-501	DAR REV: BASIC

POST TEST INSPECTION PLAN

DESCRIBE IN DETAIL ALL OF THE FOLLOWING ITEMS ANSWERED "YES" ON COMMENT SHEET. RECORD ALL UNUSUAL ITEMS AS WELL AS APPROPRIATE PHOTOS TO FULLY DOCUMENT MOTOR AND CLOSURE CONDITION.

1) Motor Inspector (Before Dis-assembly)

a) Examine the exterior of the motor case. Are there any sign of bulges, discoloration, or signs of gas flow? ☐ Yes ☑ No

b) Examine the nozzle sub-assembly.

- Are there any discolorations or signs of gas flow external to nozzle? ☐ Yes ☑ No
- Any unusual flow patterns on nozzle exit cone? ☐ Yes ☑ No
- Throat insert out of place? ☐ Yes ☑ No
- Throat insert condition abnormal? ☐ Yes ☑ No

c) Examine the igniter assembly exterior. Is there any discoloration or signs of gas flow? ☐ Yes ☑ No ☐ N/A (if not in place)

2) Aft Closure (After Dis-assembly).

Note: The design intent is for none of the following events to occur.

a) Examine the 2 O-ring seal areas of the Aft closure.

(Do not remove the O-rings at this time)
Is there an evidence of gas leak or O-ring char or ablation? ☑ Yes ☐ No
Any evidence of O-ring groove or O-ring seal surface damage?

b) Any evidence of thread damage? ☐ Yes ☑ No

c) Any evidence of unusual ablation to aft closure insulation? ☐ Yes ☑ No

3) Motor Case Insulation.

After disassembly of the motor, visually examine the motor case interior (using APPROPRIATE lighting and inspection equipment). Record the conditions listed below. (The design intent is for none of the following events to occur).

a) Examine the 2 O-ring seal areas at the igniter interface. Is there any evidence of gas leakage or O-ring char or ablation? ☐ Yes ☑ No

b) Examine the 2 O-ring seal areas of the closure interface. Is there any EVIDENCE of gas leakage? ☐ Yes ☑ No

c) Are there any signs of irregular erosion? ☐ Yes ☑ No

4) Igniter Assembly.

(The design intent is for none of the following events to occur.)

a) Examine the O-ring seal areas of the igniter. (Do not remove the O-ring at this time.) Is there any evidence of gas leakage or O-ring char or ablation? ☐ Yes ☑ No

b) Is there any discoloration, indication of excessive heating, or signs of gas flow? ☐ Yes ☑ No

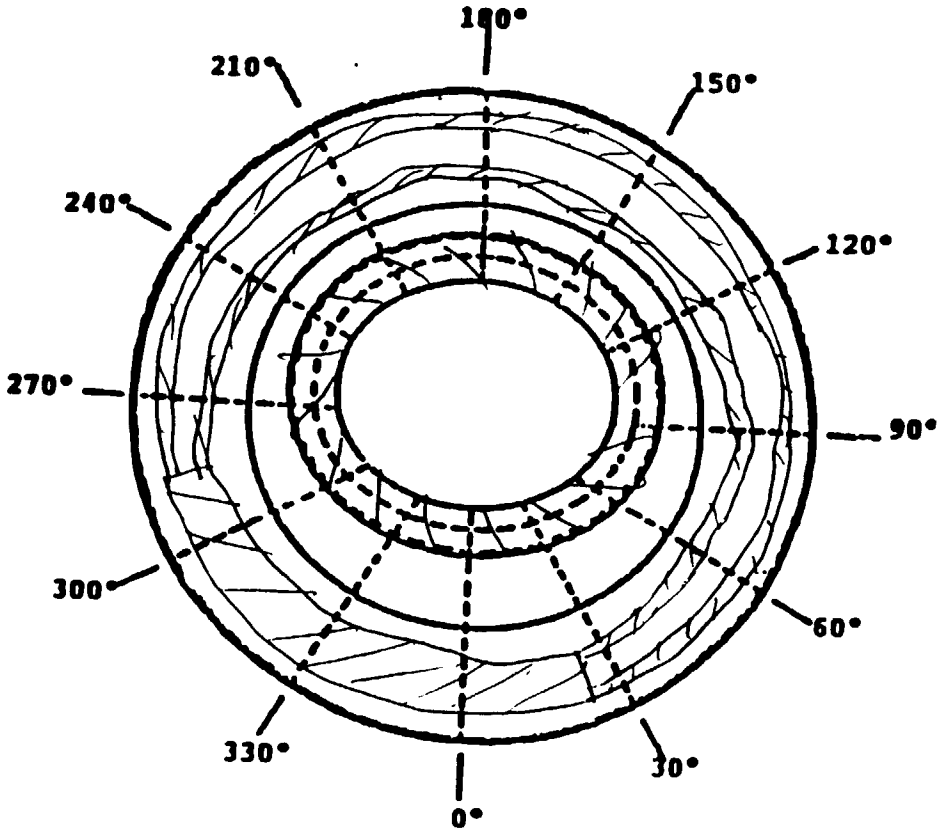
c) Did both initiators (TBIs) fire? ☑ Yes ☐ No

d) Post Test dissection. ☐ Yes ☐ No

e) Examine TBI sealing areas for evidence of gas leakage. ☐ Yes ☑ No

FIGURE 1

BSM CLOSURE-TO-INSULATOR BOND MAP



TAP TEST EXAMINATION
DATA SHEET

PART NAME	PART NUMBER/~~DRAWING/REV~~ REV. 11-10-93	PLANNING DOCUMENT #
(NOZZLE ASSY.) BSM DELTA QUAL	B12000-13-01-501	MFGA 96533
WORK INSTRUCTION — TECH #	**ACCEPT/REJECT CRITERIA**	**HAMMER SIZE**
60-12-9-590-001	PER ENG. INFO ONLY	.50 oz
TYPE OF MATERIAL	**NCR #**	**PROJECT NO/WOR #**
RUBBER	N/A	5597/5597-986-0000

ITEM S/N	IDENTIFICATION DESCRIPTION/REMARKS	ACC	REJ
1,000,738	NO UNBONDS NOTED.	ENG INFO ONLY	

SKETCH

INSPECTOR		LEVEL	DATE
Adrian Vazquez Jr.	15 FT D	II	11-10-93

CSD 3059 (92/08)

Ultrasonic Report/ Calibration Sheet

Page 1 of 2

PART NAME: BSM DELTA QUAL MOTOR TEST	WORK ORDER NUMBER: 5597-986-0000
PART NUMBER: B12000-13-E1-501	PLANNING DOCUMENT INFO. Release No.: MFGA 9653 3 / NCR No. (If applicable): NONE
Material: RUBBER	Component Serial No.: 1,000,735 / Project Name: BSM
Specification/technique: SE 1754 / 60.12.9-553	CALIBRATION CHECKS Initial: Time 0830
Quantity: Received 1 / Inspected 1 / Accepted ENG / Rejected INFO	Intermediate: Time —
Instrument/Serial Number: SONIC MK II / Calibration Date: 10-4-94	Final: Time 0930
Transducer — Size/Frequency — Serial Number: .25/10MHz/922651	INSTRUMENT SETTINGS
Scanning Method: CONTACT	Sweep C: ____ F: ____
Test Blocks/Standards: STD K371	Delay C: ____ F: ____
COUPLANT: ULTRAGEL II	dB: ____ Reject On Off
	Frequency: ____

EXAMINATION AREA	COMMENTS
SEE COMMENTS	UNABLE TO INSPECT APPROX. 32 SQ IN OF CLOSURE BECAUSE OF SURFACE ROUGHNESS DUE TO FIRING.

Michael Reedy (47 CS.) — Inspector

II — Level

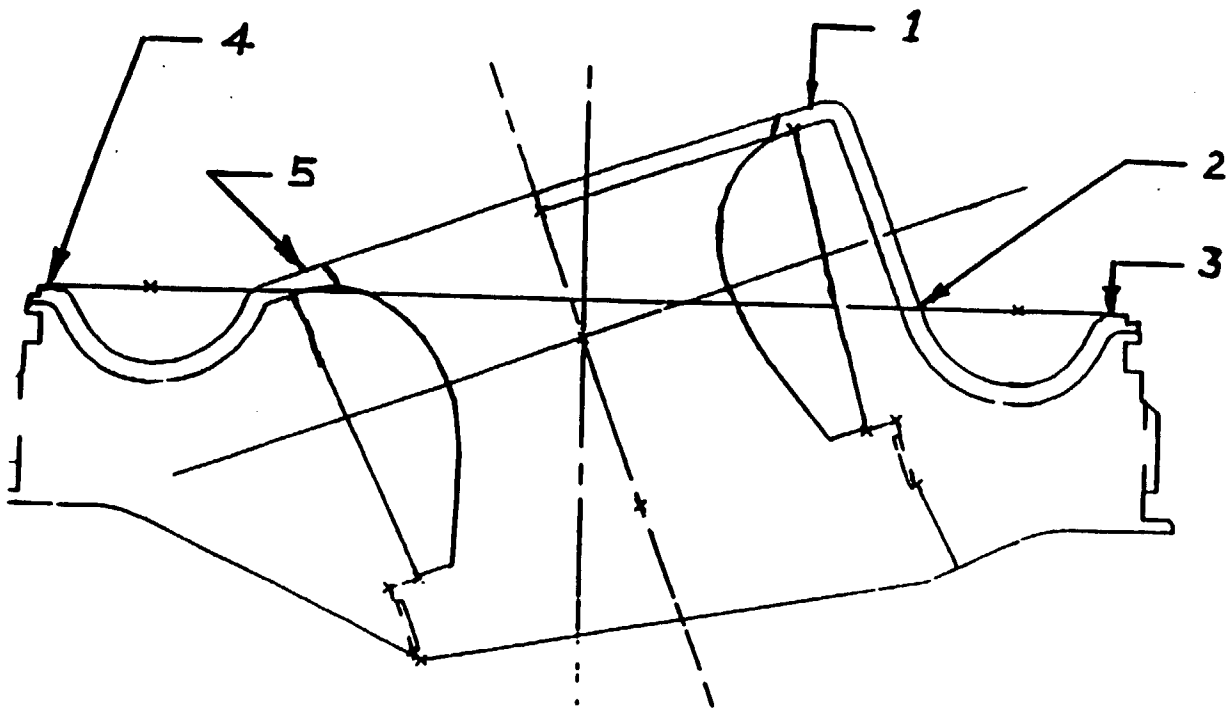
11-10-93 — Date

CSD 2795 (92/03)

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FIGURE 2

POST-TEST INSULATOR THICKNESS



PRECEDING PAGE BLANK NOT FILMED

DRAWING AND SPECIFICATION ACCOUNTABILITY LOG

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

P/N: B12000-13-01-501

RELEASE NO. MFGA 96533

REV: *1

THIS CERTIFIES THAT THE FOLLOWING CLASS II CHANGES HAVE NOT BEEN INCORPORATED INTO THE JOB RELEASE PACKAGE (JRP) FOR FABRICATION.

DRAWING REVISION EXCEPTIONS: N/A , _____ , _____ , _____ , _____

PRODUCT PLANNER: KdRenneta 8/27/93

BRANCH ENGINEER: PoR Paty 8/27/93

DOCUMENT NO.	REV	ECO's/ SCN's	TITLE	PI/MSI NUMBERS	INCORPORATED PCS NUMBER	JRP DOCUMENT (MAT/DAR/PL)	INCORPORATED PCS NUMBER
07.9.007	0		BSM Delta Qual Rocket Motor				

482

CSD 2800 (89/05)

Comment Sheet

PART NO.	SERIAL NO.	PLAN REV.	REL. NO.
B12000-13-01-501	1000738	Basic	MFGA-96533

DESCRIPTION
BSM DELTA QUAL MOTOR TEST (FWD)

ITEM NO.	STEP NO.	COMMENT:
01	D003	

Chart # 1 has out of conditioning situation for one minute . With makeup time 2 minutes were deducted from total time . Total condition time is corrected.

ORIGINATOR:	DATE:	ORGANIZATION:
B.R. Patel	9-3-93	01840

ITEM NO.	STEP NO.	COMMENT:
02	D005	

Chart # 2 cold cycle has 5 spikes on high temp. side and 4 spikes on low temp. side. These spikes are due to compressor cycling (noise) . Total time is corrected. Spike duration is less than 2 seconds.

ORIGINATOR	DATE:	ORGANIZATION:
B.R. Patel	9-3-93	01840

ITEM NO.	STEP NO.	COMMENT:
03	D008	

In Chart # 4 there two spikes on cold temp. and 10 spikes on high temp. These spikes are due to compressor cycling (noise). Spike duration is less than 2 seconds.

ORIGINATOR	DATE:	ORGANIZATION:
B.R. Patel	9-3-93	01840

ITEM NO	STEP NO.	COMMENT:
04.	D013	

In Chart # 6 there are seven spikes on on high temp. and five on cold temp. . These spikes are due to compressor cycling (noise) Spike duration is less than 2 seconds.

ORIGINATOR:	DATE:	ORGANIZATION:
B.R. Patel	9-3-93	0184

CED 2489 (89-03)

DISTRIBUTION: WHITE - STAY WITH JRP
PINK - UPON CLOSEOUT OF JRP, SHOP SUPERVISOR TO FORWARD T ORIGINATING PLANNER

C O M P L E T I O N M A T E R I A L H A N D L E R

PLANT CODE : 001 PLANNER:
PART NUMBER: B12000-13-01-501
JOB NUMBER : MFGA96533-01

MFGA96533-01

CONTRACT NUMBER : 559x
DESCRIPTION : ROCKET MOTOR ASSEMBLY, FWD -
SN/LOT CONTROL CD : S
JRP ASSGN : N

SERIAL/LOT NUM : 1000738
REVISION : *1

PAGE : 1
DATE : 08/27/93
QTY : 1.00

WOR :

ECO : BASIC

ORIGINATOR : _____

Q.E. : _____

OPERATION	WORKCENTER	SET-UP / RUN	DESCRIPTION	BUY POINTS OPS	Q.C.	CUST
9999 00 0	C0023S99	0.00	STORES STOCK PARTS			
9999 00-0		0.00	STORES/PC STOCK PARTS AND RECORD.			

LOC: _____ _____ _____ _____

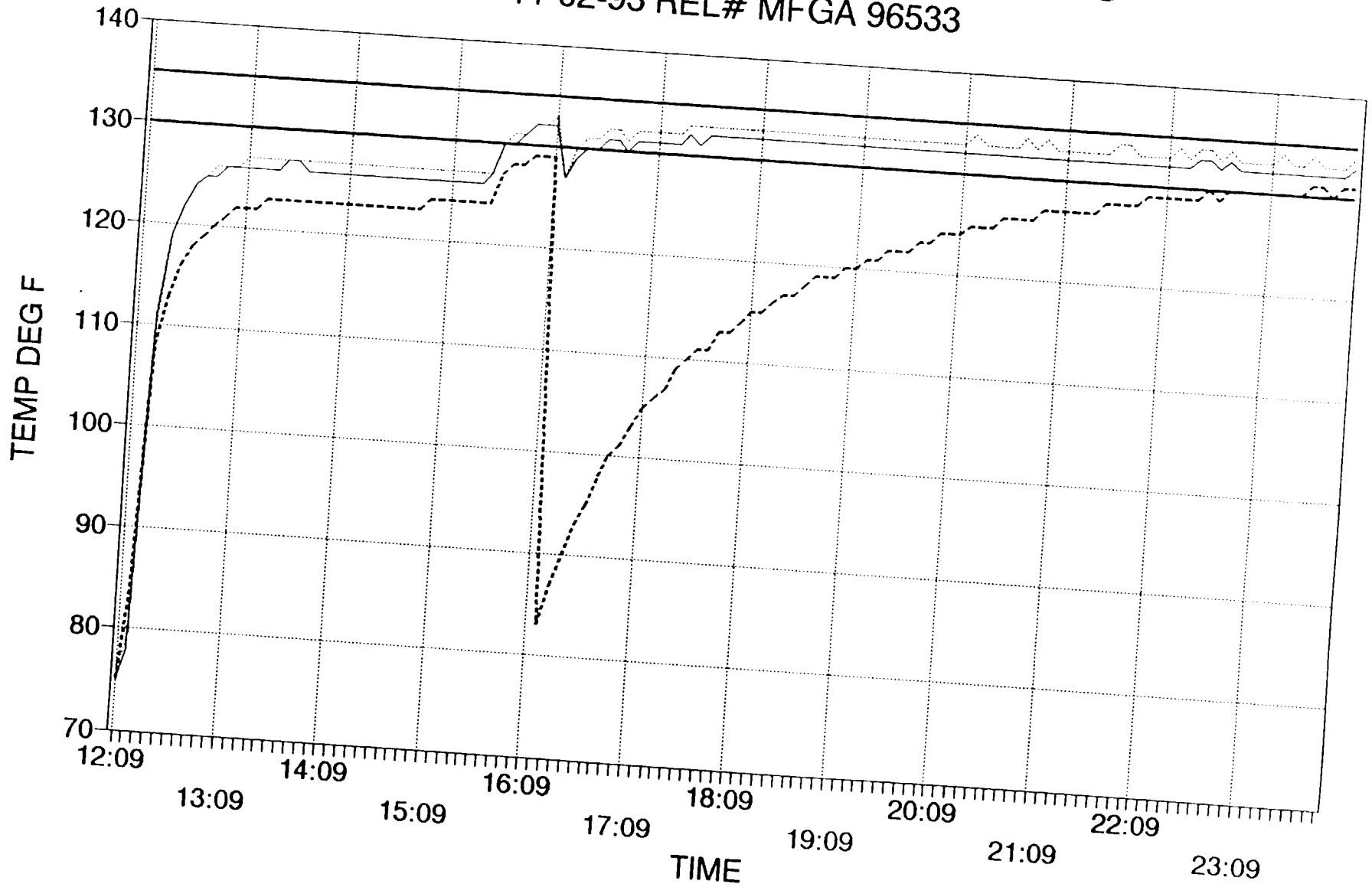
QTY: _____ _____ _____ _____

TRACE: _____ _____ _____ _____

TRANSACTION INPUT BY: _____ DATE: _____

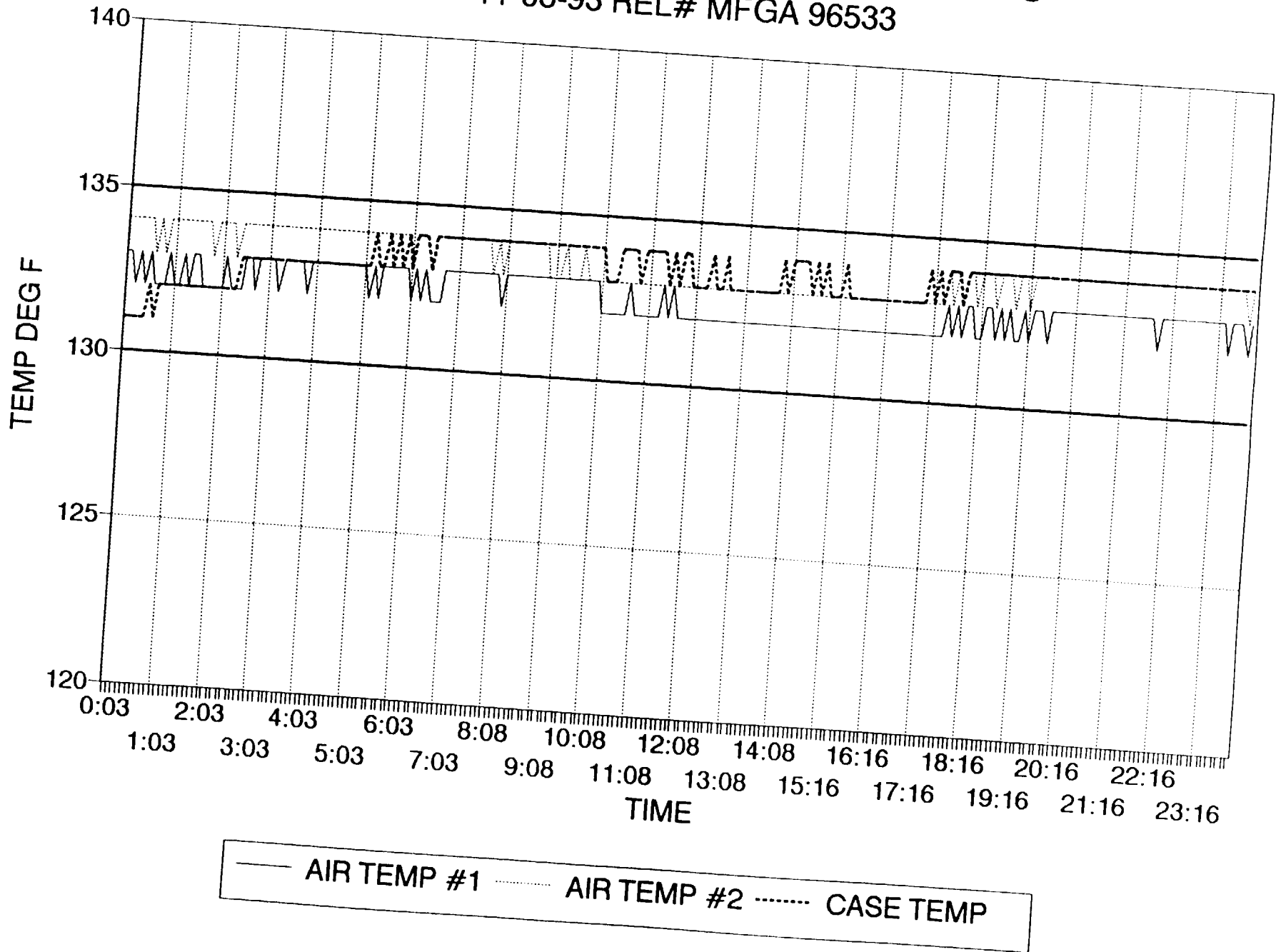
BSM DELTA QUAL S/N 1000738

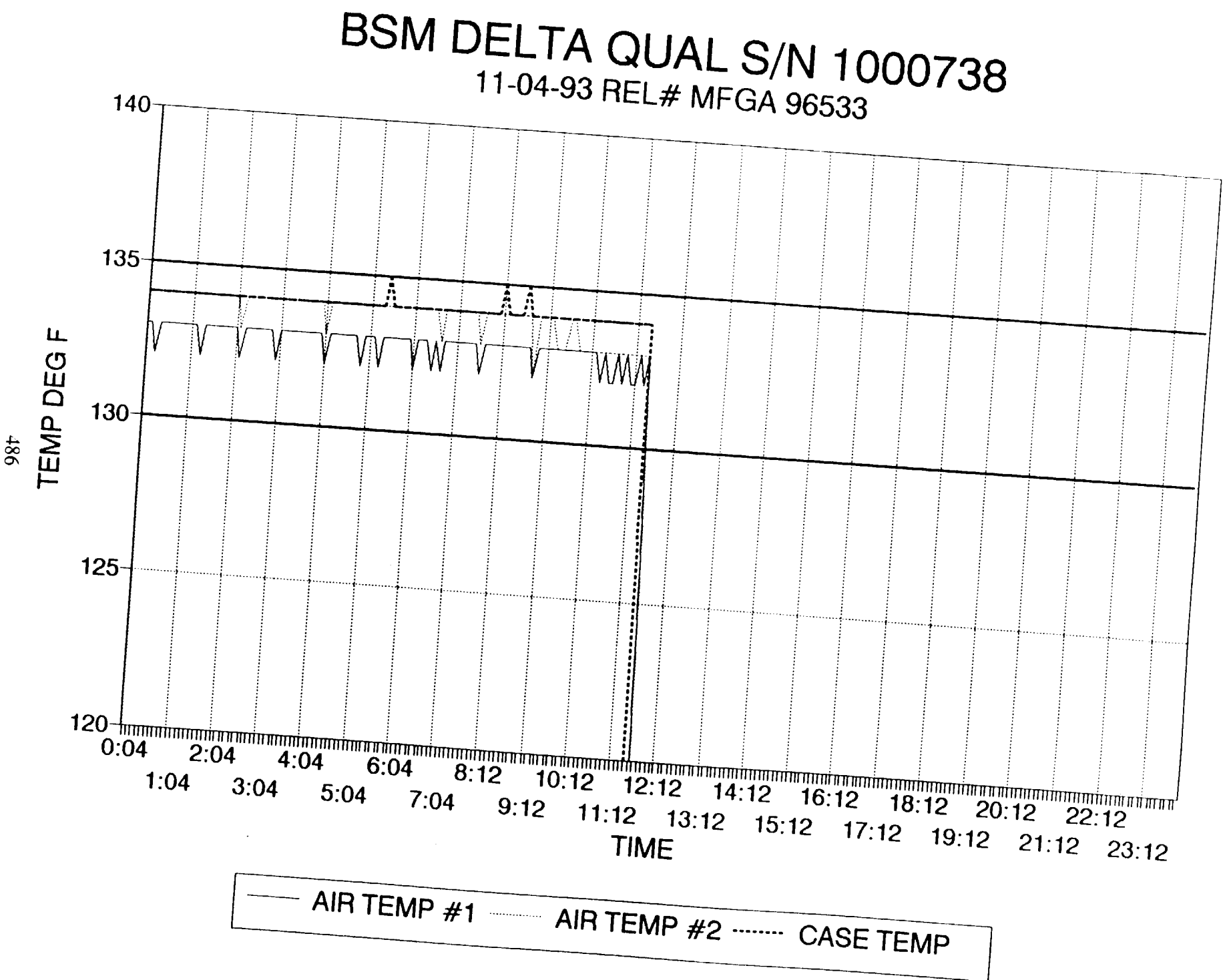
11-02-93 REL# MFGA 96533



BSM DELTA QUAL S/N 1000738

11-03-93 REL# MFGA 96533



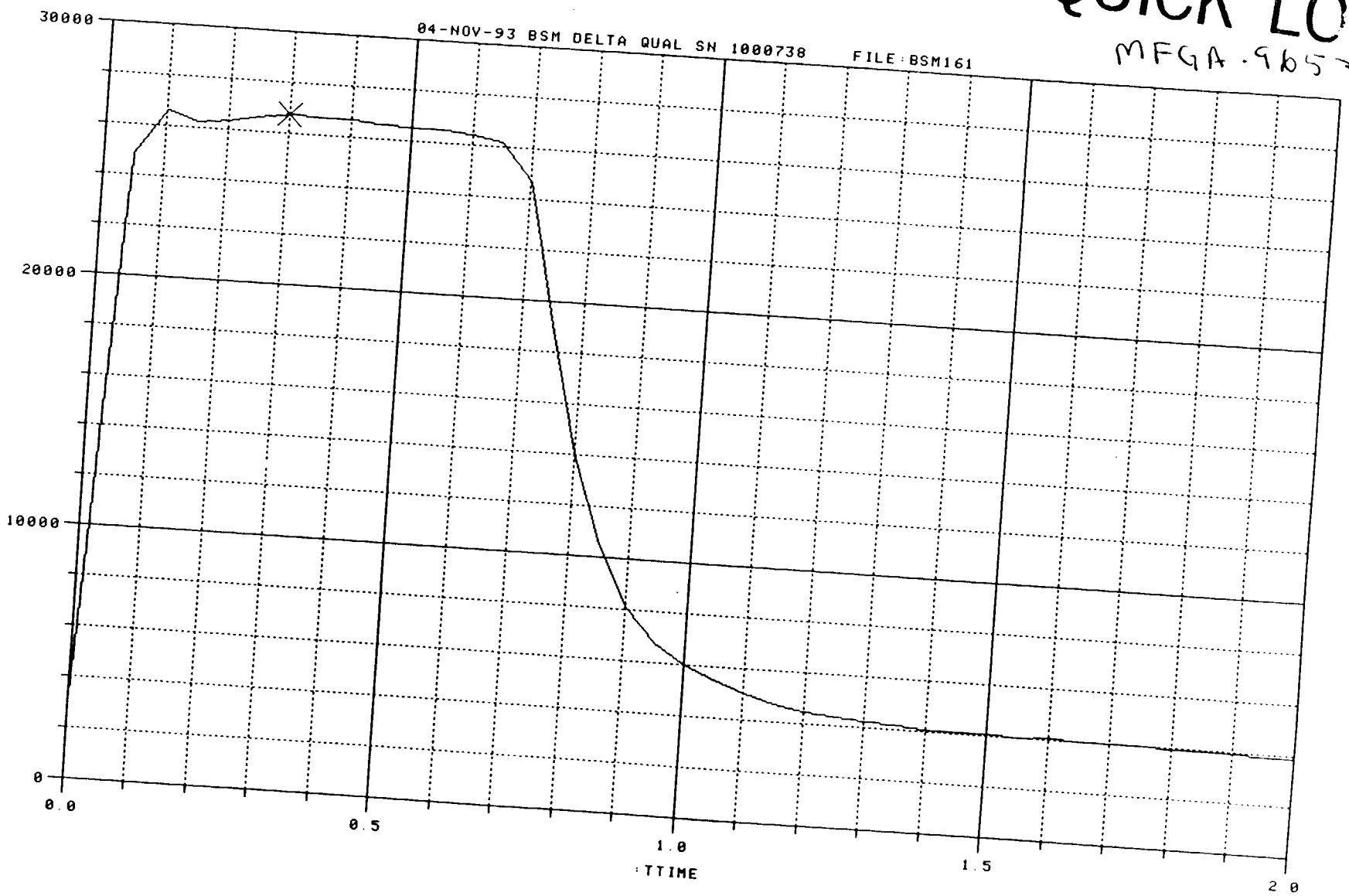

BSM DELTA QUAL S/N 1000738
11-04-93 REL# MFGA 96533
TEMP DEG F
140
135
130
125
120
0:04
1:04
2:04
3:04
4:04
5:04
6:04
7:04
8:12
9:12
10:12
11:12
12:12
13:12
14:12
15:12
16:12
17:12
18:12
19:12
20:12
21:12
22:12
23:12
TIME
AIR TEMP #1
AIR TEMP #2
CASE TEMP

CHEMICAL SYSTEMS DIVISION
ONLINE TEST AREA GRAPHICS SYSTEM

MA .130 - .5°F

QUICK LOOK

MFGA-96533



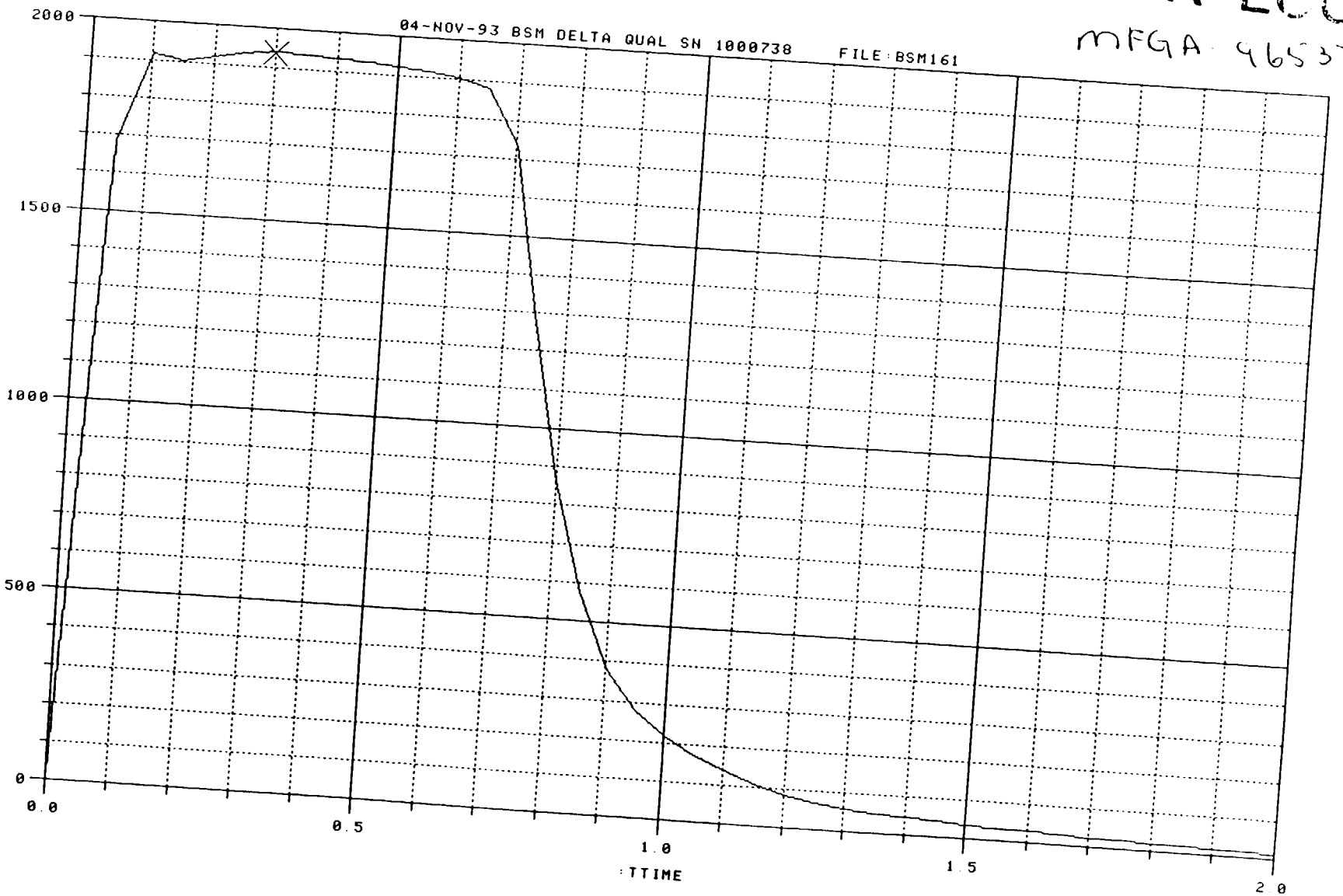
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x
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487

CHEMICAL SYSTEMS DIVISION
ONLINE TEST AREA GRAPHICS SYSTEM

Hot 130-135°

QUICK LOOK

MFGA 96533



488 PC-2

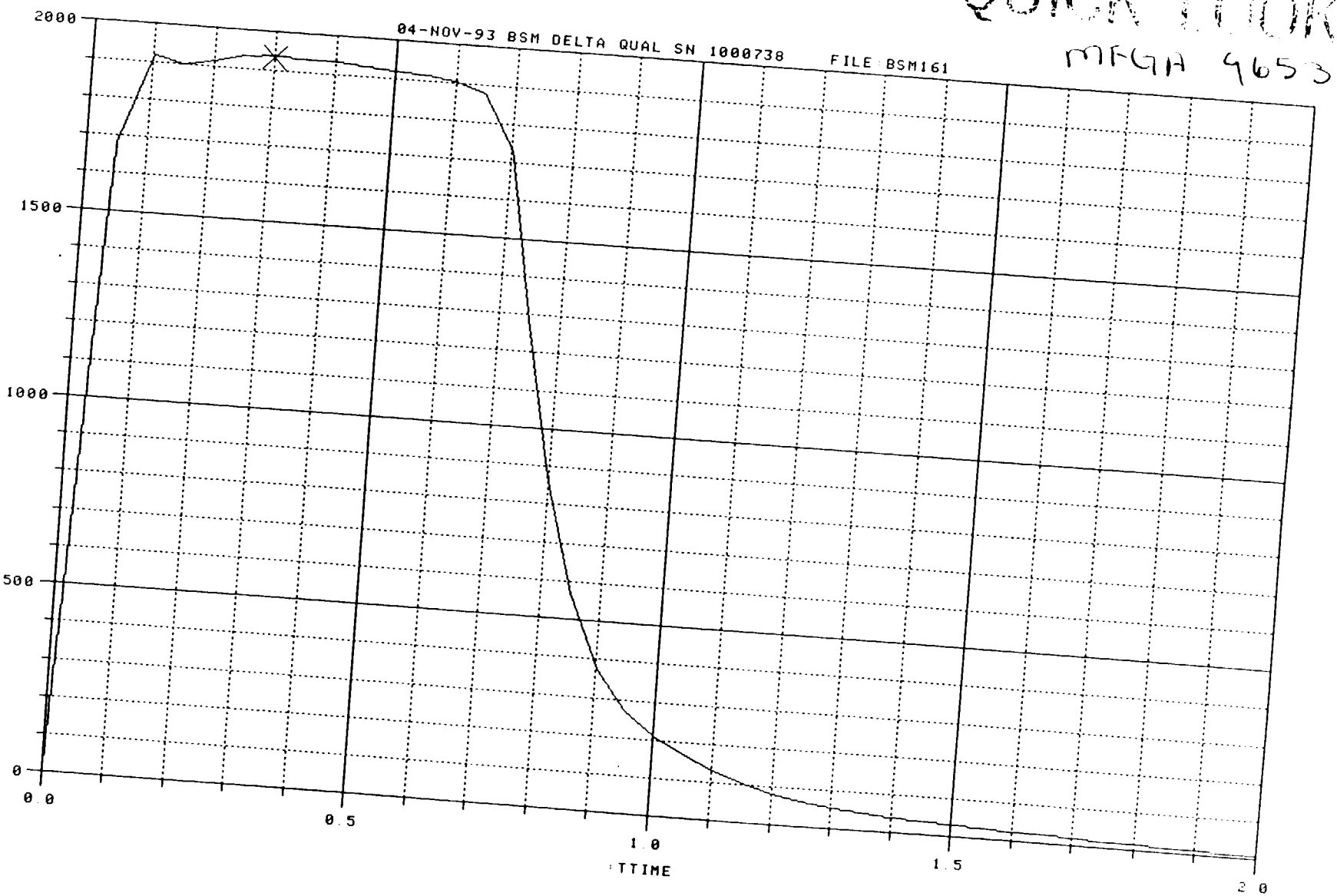
1932.16

CHEMICAL SYSTEMS DIVISION
ONLINE TEST AREA GRAPHICS SYSTEM

Hot 130-135° F

QUICK LOOK

MFG# 96533



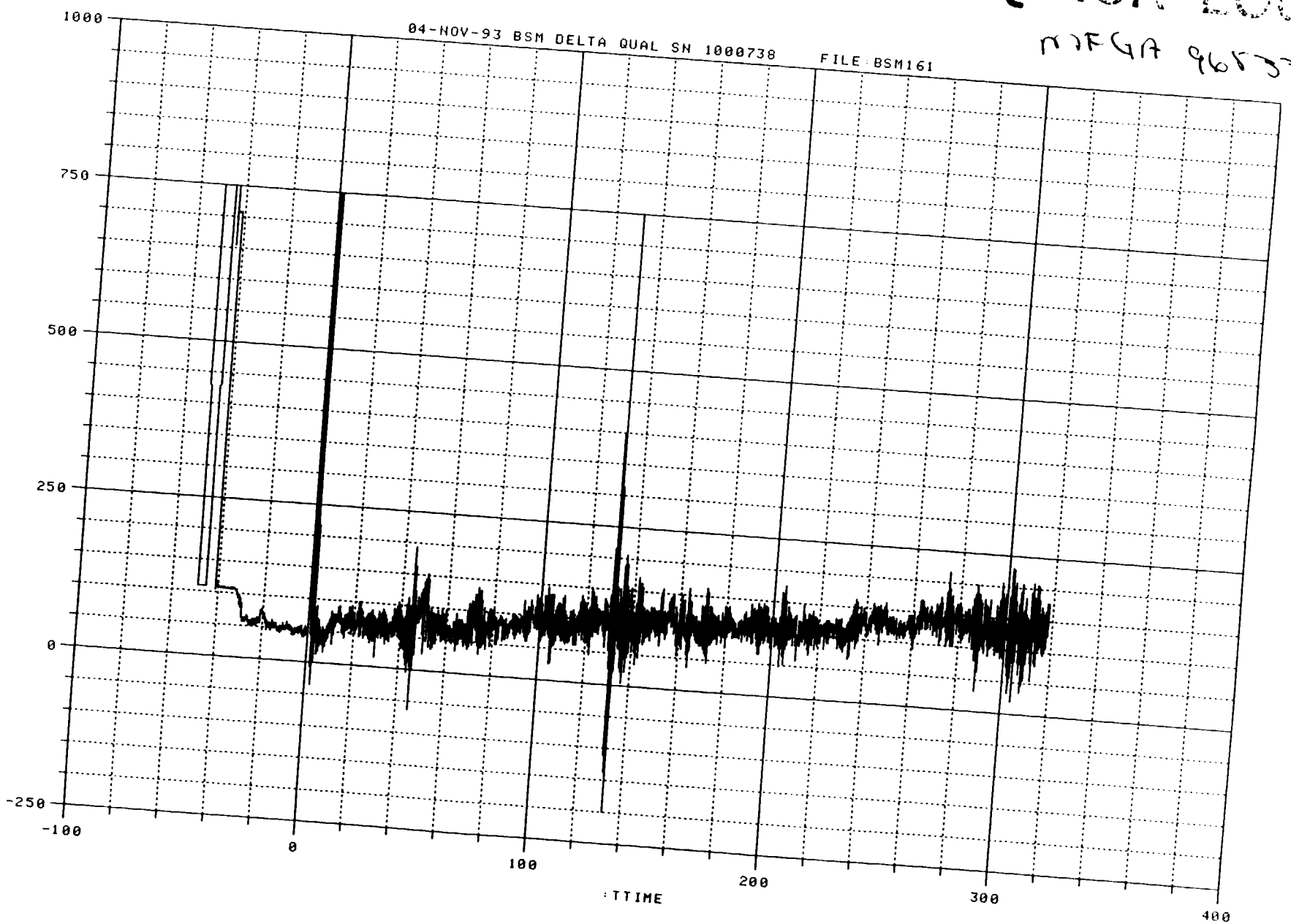
489
PC-1

CHEMICAL SYSTEMS DIVISION
ONLINE TEST AREA GRAPHICS SYSTEM

HOT 180-12 °F

QUICK LOOK

MFGA 96533



490
T
1

CHEMICAL SYSTEMS DIVISION

DATE: 30-AUG-1993 13:19:36 PAGE:
TEST DATE: - -

SDC NUMBER 161-93 TEST LOCATION: ST-3 Bob Patel 9/4/93

TEST ENGINEER: B. R. PATEL INSTRUMENTATION ENGINEER: L. THOMPSON

BAROMETRIC PRESSURE: 29.24 HUMIDITY: 35% AIR TEMPERATURE: 71°

DESCRIPTION: BSM DELTA QUAL SN 1000738 FILE:BSM16193 (WOR 5597-986-00XX)

CHEMICAL SYSTEMS DIVISION

SDC NUMBER 161-93 TEST LOCATION:ST-3
DESCRIPTION:BSM DELTA QUAL SN 1000738

SYSTEM ID:NF-0 SAMPLE RATE: 1000
FILE:BSM16193 (WOR 5597-986-00XX)

DATE: 3-SEP-1993 08:12:27
TEST DATE: - -

ITEM	NAME	CLS	ICN NUMBER	DESCRIPTION	EXP MIN	EXP MAX	UNTS	CHN	LO FAC	HI FAC	DIV	PGA GAIN	CAL CODE
1	PC-1	U	A44025206	CHAMBER PRESSURE #1 (HEAD END)	0.	3000.	PSIA	14	0.	1459.308	200	1	
2	PC-2	U	A4402 5226	CHAMBER PRESSURE #2 (HEAD END)	0.	3000.	PSIA	17	0.	1487.4	200	1	
3	ES-1A	U		SQUIB VOLTAGE#1A	0.	25.0	VDC	36	0.	20.0	10	2	10
4	IS-1A	U		SQUIB CURRENT#1A	0.	10.0	AMP	38	0.	0.5	10	1	3
5	FXA	U	A44032205	AXIAL FORCE, A BRIDGE	0.	25000.	LBF	0	0.	25175.0	200	2	6
6	FXB	U	A44032205	AXIAL FORCE, B BRIDGE	0.	25000.	LBF	1	0.	25180.0	200	2	6
7	FXCA	U	A44032206	AXIAL FORCE CALIBRATION,A BRIDGE	-25000.	25000.	LBF	2	0.	12472.5	200	2	6
8	FXCB	U	A44032206	AXIAL FORCE CALIBRATION,A BRIDGE	-25000.	25000.	LBF	3	0.	12495.0	200	2	6
9	FYAA	U	A44030601	SIDE FORCE AFT IN YAXIS	-1000.0	1000.0	LBF	4	0.	499.45	200	2	6
10	FYFA	U	A44031211	SIDE FORCE FWD IN YAXIS	-5000.0	5000.0	LBF	5	0.	2500.25	200	2	6
11	FZ1A	U	A44031221	VERTICAL FORCE AFT IN ZAXIS LEFT	-5000.0	5000.0	LBF	6	0.	2506.75	200	2	6
12	FZ2A	U	A44031222	VERTICAL FORCE AFT IN ZAXIS	-5000.0	5000.0	LBF	7	0.	2495.75	200	2	6
13	FZ3A	U	A44031220	VERTICAL FORCE FWD IN ZAXIS	-5000.0	5000.0	LBF	8	0.	2499.0	200	2	6
14	ES-1B	U		SQUIB VOLTAGE#1B	0.	25.0	VDC	37	0.	20.0	10	2	10
15	IS-1B	U		SQUIB CURRENT#1B	0.	10.0	AMP	39	0.	0.5	10	1	3
16	T1	U		EXTERNAL TC FOR QUAL 3.38" AFT	0.	100.	DEGF	48			500	2	12

CHEMICAL SYSTEMS DIVISION

SDC NUMBER 161-93 TEST LOCATION:ST-3
DESCRIPTION:BSM DELTA QUAL SN 1000738

SYSTEM ID:NF-0 SAMPLE RATE: 1000
FILE:BSMI6193 (WOR 5597-986-00XX)

DATE: 30-AUG-1993 13:19:38
TEST DATE: - -

ITEM	NAME	CLS	ICN NUMBER	DESCRIPTION	EXP MIN	EXP MAX	UNTS	CHN	LO FAC	HI FAC	DIV	PGA GAIN	CAL CODE
32	TREF	U	~~A4401 5008~~ A4401 5003	REF TEMP	0.	100.	DEGF	63	0.0	~~1.79157~~ 1.79277	10	2	20

11-4-93

11-4-93

867 CSD

493

CHEMICAL SYSTEMS DIVISION

SDC NUMBER 161-93 TEST LOCATION:ST-3 SYSTEM ID:NF-Ø SAMPLE RATE: 1ØØØ DATE: 3-SEP-1993 Ø8:12:27 PAGE: 4 of

DESCRIPTION:BSM DELTA QUAL SN 1ØØØ738 FILE:BSM16193 (WOR 5597-986-ØØXX) TEST DATE: - -

ITEM	NAME	CLASS	ICN NUMBER	CABLE	CHAN	MODE CARD	GAIN	DIV FILTER	AMP CARD	BFR CH	BFR GN	OFFSET	K-FAC SENS	NOTE	11-2-93 INSTALL	11-2-93 END TO END
1	PC-1	U		269-ØØ-Ø	14	5Ø2	2ØØ	2ØØ 25Ø	5Ø	Ø1 - .7					867 CSD	867 CSD
2	PC-2	U		269-ØØ-Ø	17	5Ø2	2ØØ	2ØØ 25Ø	5Ø	ØØ - ØØ					867 CSD	867 CSD
3	ES-1A	U		296-ØØ-Ø	36	5Ø4	1Ø	1Ø 1ØØØ	56	Ø3 - .7					867 CSD	867 CSD
4	IS-1A	U		296-ØØ-Ø	38	5Ø4	1Ø	1Ø 1ØØØ	56	Ø4 - .7					867 CSD	867 CSD
5	FXA	U		269-ØØ-Ø	Ø	5Ø2	2ØØ	2ØØ 25Ø	5Ø	Ø7 - .7					867 CSD	867 CSD
6	FXB	U		269-ØØ-Ø	1	5Ø2	2ØØ	2ØØ 25Ø	5Ø	ØØ - ØØ					867 CSD	867 CSD
7	FXCA	U		269-ØØ-Ø	2	5Ø2	2ØØ	2ØØ 25Ø	5Ø	Ø8 - .7					867 CSD	867 CSD
8	FXCB	U		269-ØØ-Ø	3	5Ø2	2ØØ	2ØØ 25Ø	5Ø	ØØ - ØØ					867 CSD	867 CSD
9	FYAA	U		269-ØØ-Ø	4	5Ø2	2ØØ	2ØØ 25Ø	5Ø	-					867 CSD	867 CSD
1Ø	FYFA	U		269-ØØ-Ø	5	5Ø2	2ØØ	2ØØ 25Ø	5Ø	-					867 CSD	867 CSD
11	FZ1A	U		269-ØØ-Ø	6	5Ø2	2ØØ	2ØØ 25Ø	5Ø	-					867 CSD	867 CSD
12	FZ2A	U		269-ØØ-Ø	7	5Ø2	2ØØ	2ØØ 25Ø	5Ø	-					867 CSD	867 CSD
13	FZ3A	U		269-ØØ-Ø	8	5Ø2	2ØØ	2ØØ 25Ø	5Ø	-					867 CSD	867 CSD
14	ES-1B	U		296-ØØ-Ø	37	5Ø4	1Ø	1Ø 1ØØØ	56	Ø5 - .7					867 CSD	867 CSD
15	IS-1B	U		296-ØØ-Ø	39	5Ø4	1Ø	1Ø 1ØØØ	56	Ø6 - .7					867 CSD	867 CSD
16	T1	U		- -	48	5Ø4	1ØØ	5ØØ 1Ø	5Ø	-					867 CSD	867 CSD

11-2-93 11-2-93

494

CHEMICAL SYSTEMS DIVISION

SDC NUMBER 161-93 TEST LOCATION:ST-3 SYSTEM ID:NF-Ø SAMPLE RATE: 1ØØØ

DESCRIPTION:BSM DELTA QUAL SN 1ØØØ738 FILE:BSM16193 (WOR 5597-986-ØØXX)

DATE: 3Ø-AUG-1993 13:19:36 PAGE: 5
TEST DATE: _ _

ITEM	NAME	CLASS	ICN NUMBER	CABLE	CHAN	MODE GAIN CARD	DIV FILTER	AMP CARD	BFR CH	BFR GN	OFFSET	K-FAC SENS	NOTE	INSTALL	END TO END
32	TREF	U	A44015003	- -	63	5Ø8	1Ø 1Ø	3Ø	5Ø	-		1.75277		11-2-93	11-2-53

CHEMICAL SYSTEMS DIVISION

SDC NUMBER 161-93 TEST LOCATION:ST-3
DESCRIPTION:BSM DELTA QUAL SN 1000738

SYSTEM ID:WB-1 SAMPLE RATE: 1000
FILE:BSM16193 (WOR 5597-986-00XX)

DATE: 30-AUG-1993 13:19:38
TEST DATE: - -

ITEM	NAME	CLS	ICN NUMBER	DESCRIPTION	EXP MIN	EXP MAX	UNTS	CHN	LO FAC	HI FAC	DIV	PGA GAIN	CAL CODE
49	PC-1	U	A4402520G	CHAMBER PRESSURE #1	0	3000	PSIA	14	0	1455.202			
50	ES-1A	U		SQUIB VOLTAGE 1A	0	25	VDC	36	0	20.0			
52	IRIG	U		TIMING IRIG	0	1000	HZ		-	-			

CHEMICAL SYSTEMS DIVISION

SDC NUMBER 161-93 TEST LOCATION:ST-3 SYSTEM ID:WB-1 SAMPLE RATE: 1000

DESCRIPTION:BSM DELTA QUAL SN 1000738 FILE:BSM16193 (WOR 5597-986-00XX)

DATE: 30-AUG-1993 13:19:36 PAGE: 7
TEST DATE: _ _

ITEM	NAME	ICN NUMBER	CABLE	JBOX CH	AMP CH	SIG CDX	SIG CDX GAIN	RCDR TRK/CHN	STEP/SPAN LO	STEP/SPAN HI	OFF SET	K-FAC SENS	NOTE	
49	PC-1	AW902520C	- -									1455.28		11-3-93 INSTALL
50	ES-1A		- -			A-1		01-01	0-000	3-000				END TO END
52	IRIG		- -			A-3		03-03	1-000	2-000				
								07-00	-	-				

867 CSD

11-3-93

SYSTEM DATA CHART NO. 161-93

CONFIGURATION SECTION

TEST DESCRIPTION:	NOTES:
BSM	

BRUSH RECORDER SETUP

NAME	K FACTOR	EXP MIN	EXP MAX	UNITS	CABLE	BRUSH CHANNEL	STEP LO	STEP HI	INSTALL	END-TO-END
									11-2-93	11-2-93
PC1	1499.208 PSIG	0	3000	PSIG		1	0-0.0	3-5.0	867 CSD	867 CSD
						2				
ES-1A	20.0 VOLTS	0	25	VDC		3	1-0.0	2-7.5		
IS-1A	5.0 AMPS	0.0	10.0	AMP		4	1-5.0	2-7.5	867 CSD	867 CSD
FXA	25175.0 LBS	0	25,000	LBF		7	0-0.0	3-5.0	867 CSD	867 CSD
FXCA	12472.5 LBS	-25,000	25,000	LBF		8	0-5.0	3-7.5		867 CSD
ES-1B	20.0 VDC	0.0	25.0	VDC		5	1-0.0	2-7.5	867 CSD	
IS-1B	5.0 AMPS	0.0	10.0	AMP		6	1-5.0	2-7.5	867 CSD	
									11-2-93	11-2-93

SYSTEM DAIA CHART NO. 161-93

CONFIGURATION SECiION

PAGE 9 of 20

TEST DESCRIPTION:	NOTES:
BSM	

HANZON DATA LOGGER

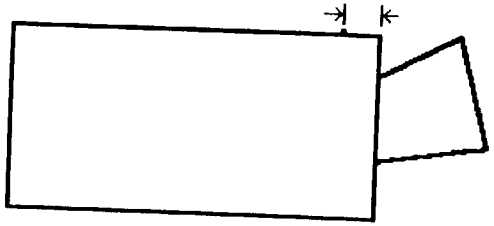
NAME	DESCRIPTION	EXP MIN	EXP MAX	UNITS	CABLE	LOGGER CHANNEL	STEP LO	INSTALL	END TO END
TI	EXTERNAL TC 3.38"	-30	500	DEGF		1			
						2		11-2-93	11-2-93
						3			
						4			

SYSTEM D. CHART NO. 161-93 CONFIGURATION SEC..ON PAGE 10 of 30

TEST DESCRIPTION:	NOTES:
BSM	

TC-1

EXTERNAL TC FOR DELTA QUAL 3.38"



MONITOR FOR 5 MINUTES AFTER Tzero

500

TEST DESCRIPTION:	NOTES:
BSM	

MACSYM 120 SYSTEM DATA CHART

CHAN NUM	LABEL	UNITS	CAL CODE	DIVIDER	LO KFAC	HI KFAC	LIMIT FLAG	LOW LIMIT	HIGH LIMIT	FACILITY FLAG	INSTALL	END TO-END
1	DAT4 / A1	PSIA	4	200				0	3000.0			
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												

501

SYSTEM DATA CHART NO. 161-93

CONFIGURATION SECTION

TEST DESCRIPTION:	NOTES:
BSM	

MACSYM 120 SYSTEM DATA CHART

CHAN NUM	LABEL	UNITS	CAL CODE	DIVIDER	LO KFAC	HI KFAC	LIMIT FLAG	LOW LIMIT	HIGH LIMIT	FACILITY FLAG	INSTALL	END TO-END
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												

SYSTEM DATA CHART NO. 161-93

CONFIGURATION SECTION

TEST DESCRIPTION:	NOTES:
BSM	

MACSYM 120 SYSTEM DATA CHART
HANDWIRED CHANNELS

CHAN NUM	LABEL	UNITS	FIRELINE CONSTANT	MULTIPLIER	LIMIT FLAG	LOW LIMIT	HIGH LIMIT	FAC. FLAG
25	ES1A	VDC	1.809	-5.0				
26	ES1B	VDC	1.766	-5.0				
27								
28								
29								
30			867 CSD 11-4-93					
31	E+	VDC	~~1.809~~	5.03				
32	ORD	VDC	~~1.766~~ 867 CSD 11-4-93	-4.74		22.0 ~~20.0~~ ~~24.0~~	27.0 30.0	

Per CCN 161-93-4 867 CSD 11-4-93

SYSTEM DATA CHART NO. 161 - 93

CONFIGURATION SECTION

TEST DESCRIPTION:	NOTES:
BSM	

MACSYM 120 SYSTEM DATA CHART, DAT4 PRESSURE TRACE PC-1

TIME	UPPER LIMIT	LOWER LIMIT	XMIN/ XMAX	YMIN/ YMAX
			0	0
			10	3000

TEST ENGINEER _____

**See Test Engineer for K Factor

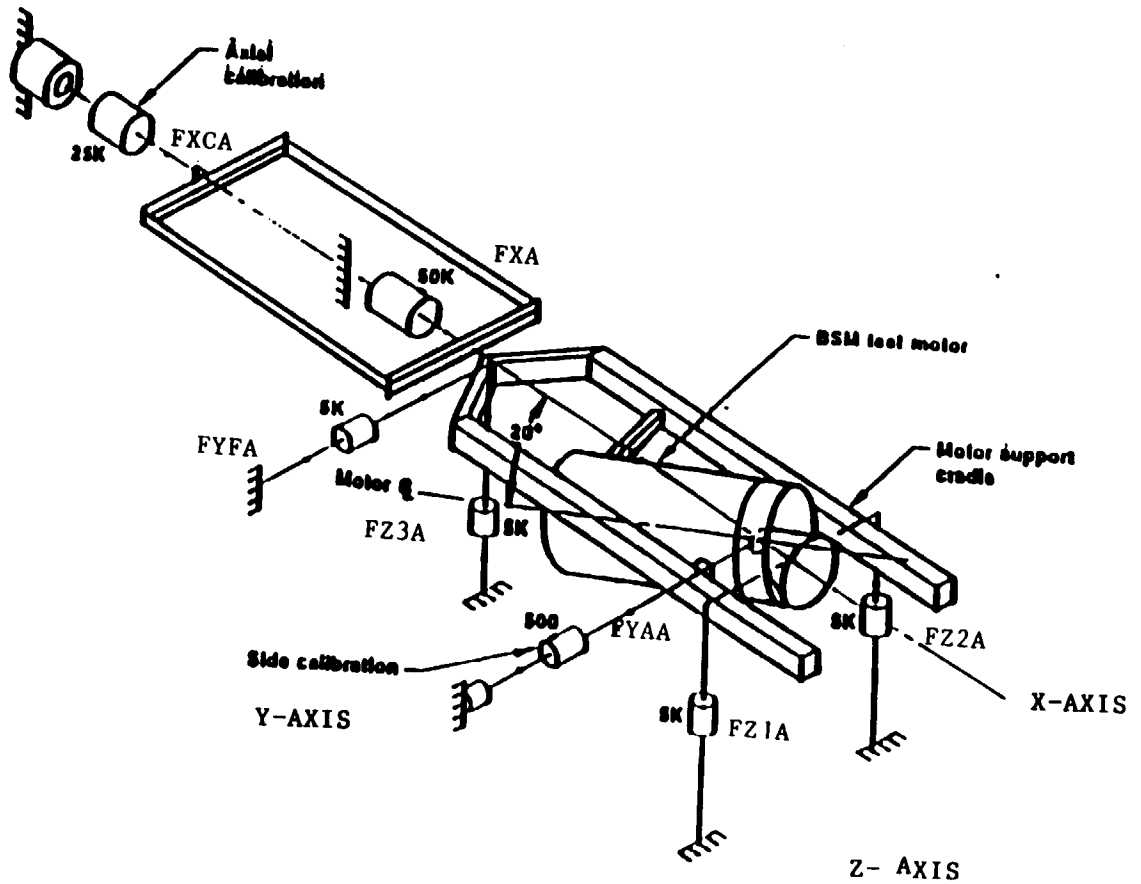
S\ A DATA CHART NO. 161 - 93

CONFIGUR AI SECTION

TEST DESCRIPTION:	NOTES:
BSM	

PAGE 15 of 20

BSM THRUST MOUNT



TEST DESCRIPTION:	NOTES:
BSM	

1. **STRAIN GAGES:**
   Adjust exitation to 5.0 + 0.0/-.1 VDC. Adjust Balance if output is greater than +/- 2000 counts.

2. **PRESS - LOAD CELLS**
   Adjust exitation to 10.0 + 0.0/- .1VDC. Adjust Balance if output is greater than +/- 2000 counts, (Load Cells only using 509 mode card).

3 **PRESS - LOAD**
   Facility type or call with load adjust exitation to 10.0 +0.0/-.1 VDC.

4. **POTS**
   Adjust exitation to 1.0 +0.0/-.1 VDC.

5. Perform end to end checks.

6. Referance configuration patching sheet for parrallel Patching.

7. **KISTLER/ PCB XDUCER**
   Set crystal amp gain to 30.0, HI FACT = K-FACT x 30, DC mode.

8. Conversion of this data to engineering units is based on factors supplied by others. Therefore data traceability to N.B.S. cannot be assured.

9. Run type K extension wire from T/C ext box to T-strip on motor case and connect T/C to T-strip.

10. Check T-Ref Peritek Temp by comparing it to a hand-held T/C meter.

C-2

506

TEST DESCRIPTION:	NOTES:
BSM	

A. Hook up instrumentation to T-strips.

B. Stamp off Installed section on SDC.

C. Hook up instrumentation to J-Boxes.

D. Adjust Exitation per SDC requirements:
If unspecified:

Strain gages	= 5 + 0.0/-.1 VDC
Pressure/Force	= 10 +/- . 1 VDC
Pots	= 1 + 0.0/-.1 VDC

E. Adjust Balance per SDC requirements:
If unspecified +/- 2000 counts.

F. Verify voltage calibrator output = 5.0 +/- .005 VDC

G. Perform end to end checks.

H. Enter K factors on SDC as follows:

a. Press, Force Pots -

Lo Factor	- Enter 0.0
Hi Factor	- Enter K factor on firing card
Cal Load Cell	- Tension K Factor
Axial Load Cell	- Comp. K Factor
Side Force Load Cell	- Avg. Tension & Compression

I. Run Caltabout on the NEFF system.

NOTE:

CAL 1 = Zero adj. +/- 165 counts (adjust at 100 box)

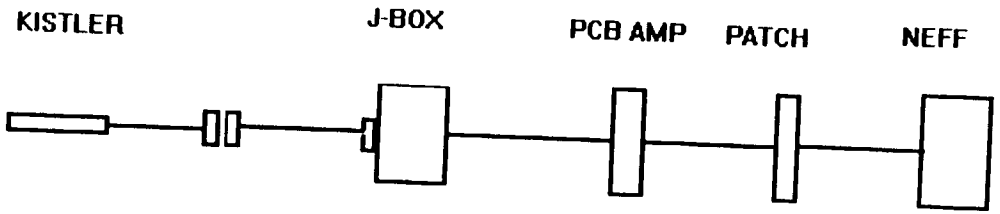
$$\text{CAL 2} = \frac{[4.9 * \text{PGA} * \text{CGAIN}]}{[305.2 \times 10\text{-}6 \text{ volt/CNT}]} = +/-.5\% +/-165 \text{ cnts}$$

J. Perform physical inspection of connectors and bay safety, clean and replace as necessary.

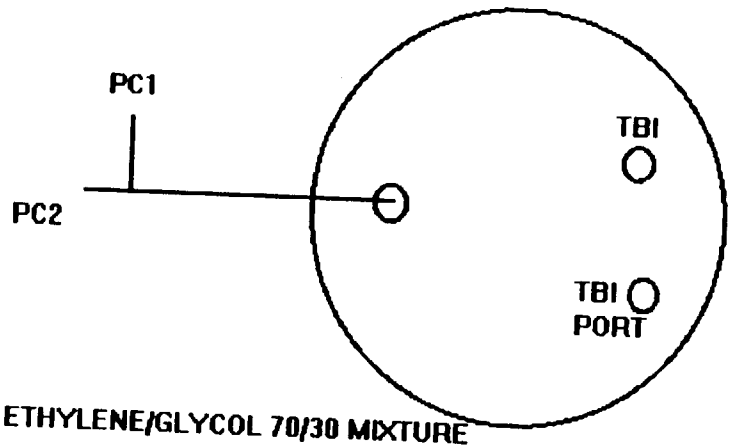
SYSTEM DATA CHART NO. 161 - 93

CONFIGURATION SECTION

TEST DESCRIPTION:	NOTES:
BSM	



AMP 484B10 IN (DC) MODE GAIN=1 AMP=6 (IF APPLICABLE)



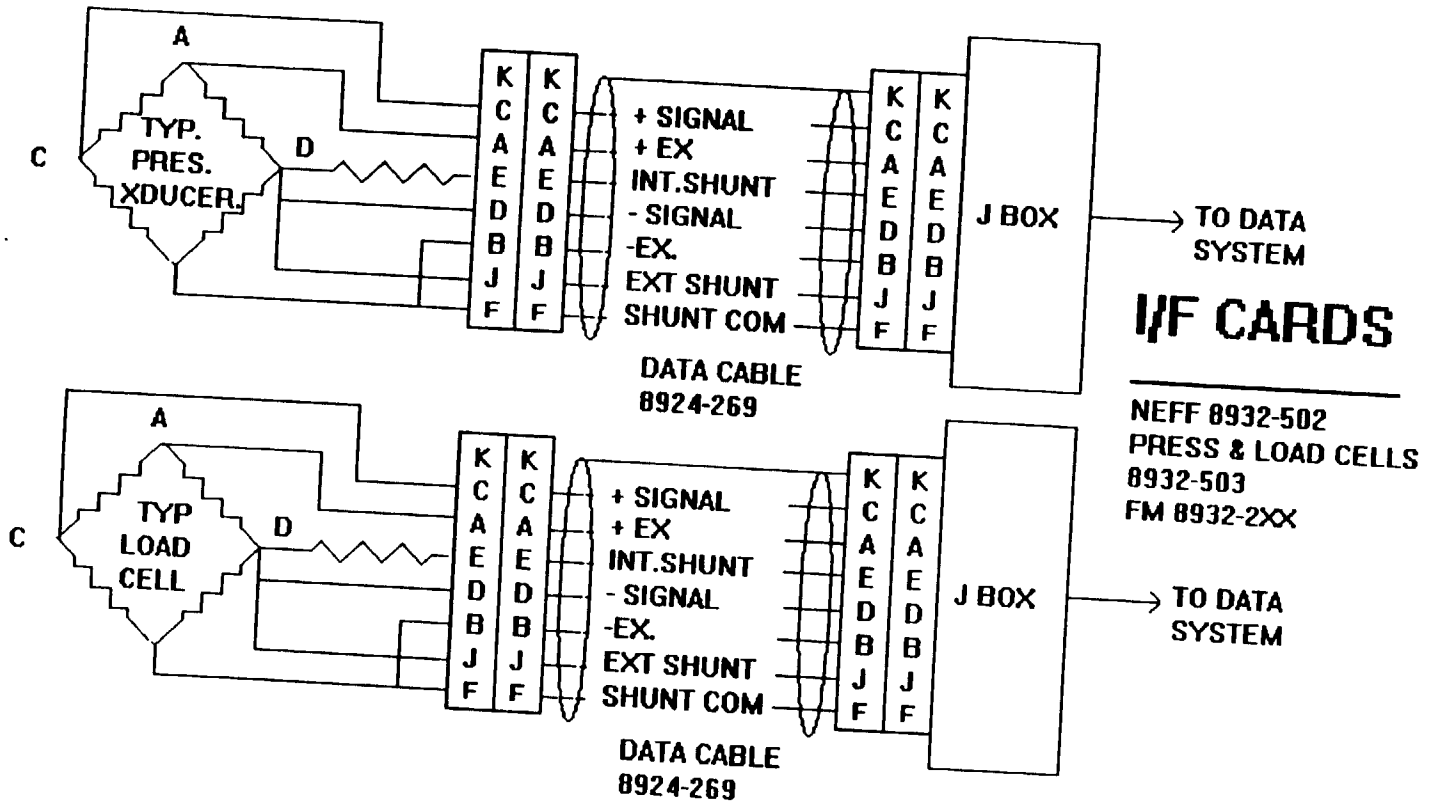
ETHYLENE/GLYCOL 70/30 MIXTURE

508

SYSTEM DATA CHART NO. 161-53

CONFIGURATION SECTION

TEST DESCRIPTION:	NOTES:
BSM	



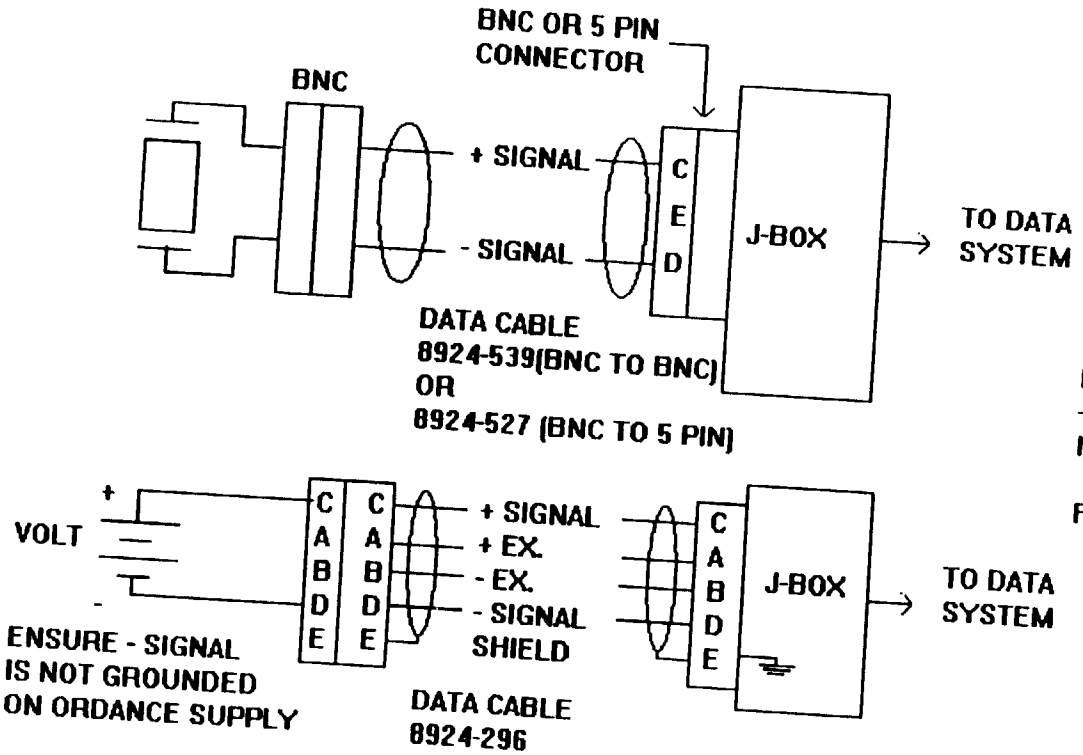
I/F CARDS

NEFF 8932-502
PRESS & LOAD CELLS
8932-503
FM 8932-2XX

SYSTEM DATA CHART NO. 161-93

CONFIGURATION SECTION

TEST DESCRIPTION:	NOTES:
BSM	



I/F CARDS FOR CRYSTAL XDUCERS

NEFF 8932-504
FM 8932-39X

I/F CARDS FOR VOLTAGE MEASUREMENTS

NEFF - 8932-504 (5MV - 10V)
8932-509 (10V - 100V)
FM - 8932-3XX

INTERNAL
CORRESPONDENCE

UNITED
TECHNOLOGIES
CHEMICAL
SYSTEM

TO: L. MURPHY

FM: I. LIZARDO

RE: BSM TEMPERATURE CONDITIONING, UPDATE (COLD MOTOR)

CC: R. HAMMOND, P. MELIA, W. HUFFERD, H. ZITZER, T. O'HARA

DT: October 15, 1993

NO: IJL-14-93E

REF: 1) Internal Correspondence, I. Lizardo to L. Murphy, "BSM Temperature Conditioning", Sept. 30, 1993, IJL-11-93E.

The two-dimensional heat transfer model, used in predicting the mean bulk temperature of the propellant for the cold motor, was updated by an additional heat flux source and the removal of an extra heat loss term. The corrected plot is shown in Figure 1.

The additional heat flux added to the model was the reflected solar heat flux from the ground. This flux was applied to the bottom half of the motor. The additional heat flux was calculated from an assumed albedo value of 0.30, a calculated incident heat flux (direct normal solar flux, I_{DN}, Reference 1), and a solar absorptivity value of 0.33 for the white paint. In other words

$$\text{Heat Flux} = \alpha_{\text{white paint}} * \text{albedo} * \text{direct normal solar flux}$$

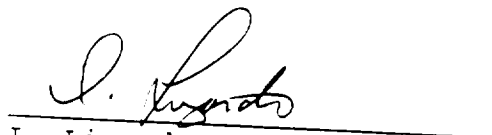
A correction was also made to the model. The present model had two heat loss term:

1) $\text{heat loss1} = \sigma \epsilon_{\text{wall, low temp}} T^4_{\text{wall}}$

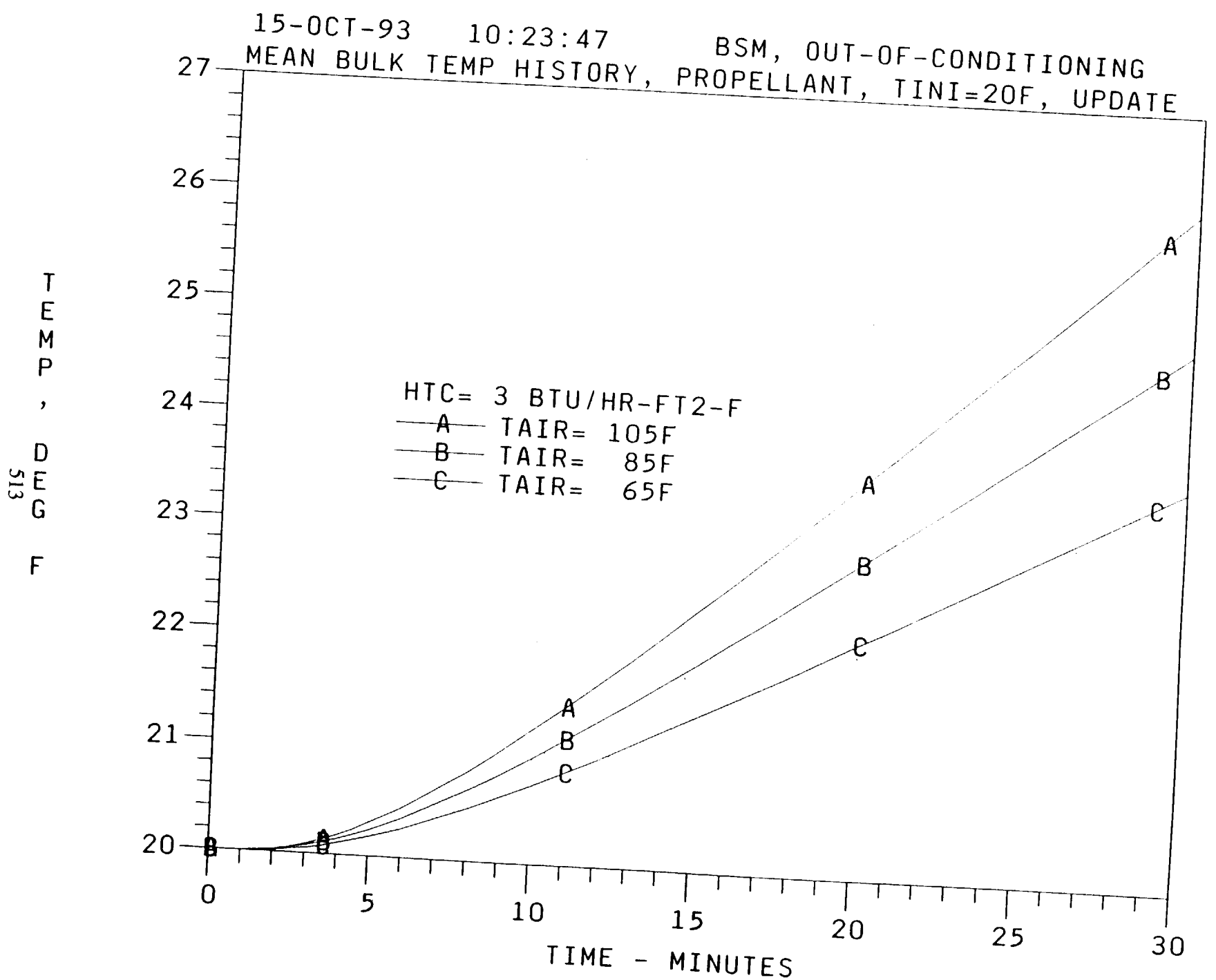
2) $\text{heat loss2} = \sigma \epsilon_{\text{wall, solar}} T^4_{\text{wall}}$

The first heat loss term (with the low temp emiss=0.81) above was applied to the entire motor. The second heat loss term (solar emiss=0.33) above, which was applied to the top half of the motor, should not have been included. The corrected current model eliminated the second heat loss term above.

In summary, the additional heat flux and the elimination of the second heat loss term above increased the meanbulk temperature of the propellant by 0.61° for Tair=105°F, by 0.58° for Tair=85°F, and by 0.56° for Tair=65°F.



I. Lizardo
Aerothermal


15-OCT-93 10:23:47
BSM, OUT-OF-CONDITIONING
MEAN BULK TEMP HISTORY, PROPELLANT, TINI=20F, UPDATE
HTC= 3 BTU/HR-FT2-F
A TAIR= 105F
B TAIR= 85F
C TAIR= 65F
TEMP, DEG F
TIME - MINUTES
27
26
25
24
23
22
21
20
0
5
10
15
20
25
30
A
B
C

OCT 2 5 1993

RCR-272-93

USBI Company
P.O. Box 1900
Huntsville, AL 35807

Attention: Mr. Bob D. Noblin
Sr. Subcontract Administrator

Subject: BSM Temperature Conditioning Analysis
USBI IEWA 018333 Prime Contract
NAS8-36300, (CSD Project 559X)

Reference:

A) USBI Ltr. TGH-074-93 dated 8 Sept. 93; Subject: "BSM Temperature Conditioning Thermal Analysis"

B) Telephone Conference on 14 Oct. 93 with; D. Wencil (USBI), T. Hopper (USBI), D. Wilson (Local USBI), B. Hammond (CSD), L. Murphy (CSD), P. Melia (CSD), I. Lizardo (CSD); Subject: "Modification of Thermal Analysis"

In response to reference (A), Chemical Systems Division (CSD) completed the subject analysis documented in Attachment 1, which was submitted to the USBI Program Management Office (PMO) on 1 October 1993 for review. The analysis was subsequently updated per direction received in reference (B). The updated analyses, documented in Attachment 2, was submitted to the USBI PMO on 18 October for review.

In accordance with subsequent verbal direction from the USBI PMO, CSD hereby formally submits the subject analysis.

Unless directed otherwise, CSD considers this task complete with this submission.

Should you have any questions, please contact Terry O'Hara, Program Manager, at (408) 776-5841 or the undersigned at (408) 776-5334.

Very truly yours,

UNITED TECHNOLOGIES CORPORATION
Chemical Systems Division

R. C. Russell, Jr.,

Contract Administrator

bcc: Attachments: B. Hammond, T. O'Hara, USBI-10 down, L. Murphy, C. Sherlock (DCMO), D. Albee, File: 559X

ATTACHMENT 1

INTERNAL
CORRESPONDENCE

UNITED
TECHNOLOGIES
CHEMICAL
SYSTEM

TO: L. MURPHY

FM: I. LIZARDO

RE: BSM TEMPERATURE CONDITIONING

CC: R. HAMMOND, P. MELIA, W. HUFFERD, H. ZITZER, T. O'HARA

DT: September 30, 1993

NO: IJL-11-93E

REF: 1) 1989 ASHRAE HANDBOOK, FUNDAMENTALS, I-P EDITION, American Society of Heating, Refrigeration and Air Conditioning Engineers, Inc., 1989.

A thermal analysis was performed on the BSM to determine the mean bulk temperature of the propellant while it is out of the conditioning box for a maximum period of thirty minutes under various thermal conditions. The propellant is considered out of conditioning if the mean bulk temperature exceeds a temperature difference of 5°F from the conditioned temperature within thirty minutes. The out-of-conditioning thermal analysis was performed for the following temperature conditions:

A. Initial motor conditioning temperature = 20°F.
   1. Tair = 105°F
   2. Tair = 85°F
   3. Tair = 65°F

B. Initial motor conditioning temperature = 130°F.
   1. Tair = 45°F
   2. Tair = 65°F
   3. Tair = 85°F

The results of the above analysis are shown in Figure 1 for cold conditioned motor and in Figure 2 for the hot conditioned motor.

Analysis Procedure

A two-dimensional transient heat transfer analysis was performed on the loaded BSM motor. The two-dimensional analysis was chosen over a one-dimensional analysis because of the geometric shape of the ID surface of the propellant. The analysis consisted of applying an external boundary condition to a two-dimensional finite element model depicting the cross-section of a BSM loaded motor. The computer code that was used in the analysis is CSD's two-

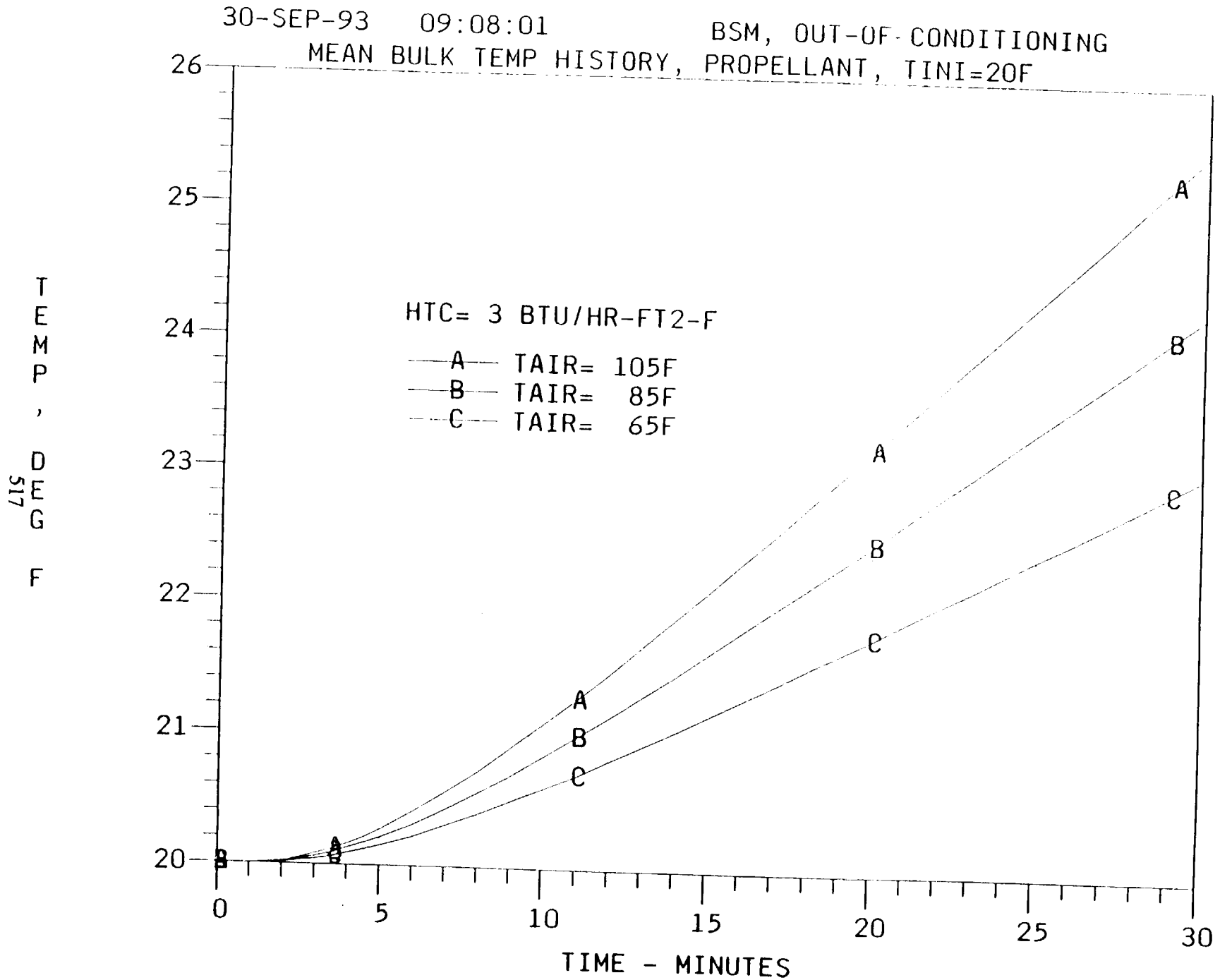


Figure 1. Out-of-conditioning, Cold Motor (T_{init}=20°F)

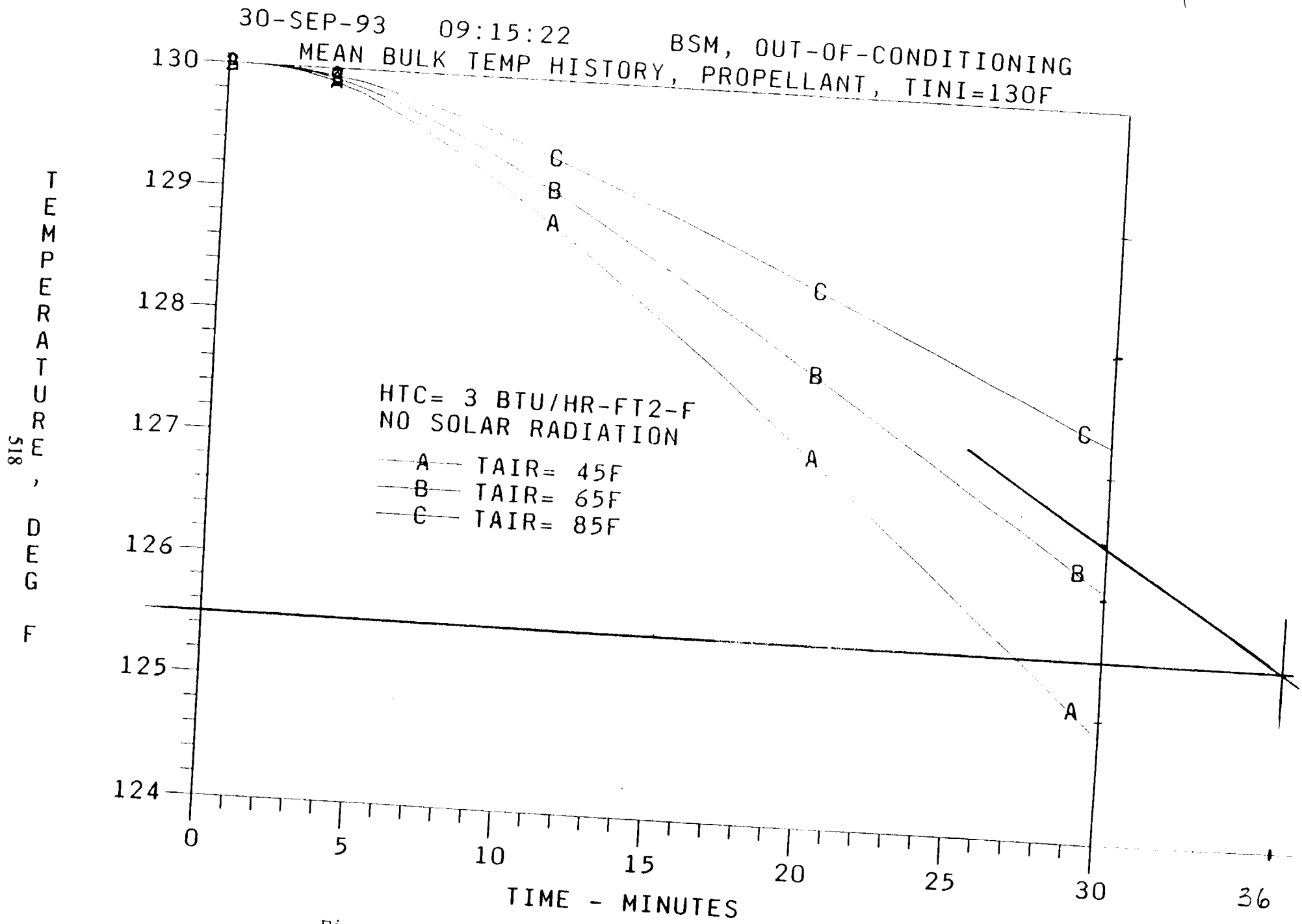


Figure 2. Out-of-conditioning

dimensional heat transfer code, DOT. It is a general two-dimensional planar or axisymmetric finite element heat transfer computer program, performing both steady-state and transient non-linear heat transfer analysis. It uses anisotropic thermal material properties that are a function of temperature and is capable of handling time and temperature variant convective and radiative boundary conditions; along with surface recession and impressed temperature boundary conditions. Besides generating nodal temperature histories, DOT also outputs the mean bulk temperature of specified materials as a function of time.

Analysis Details

A two-dimensional planar finite element model, Figure 3, was generated from the cross-section of the BSM motor (Figure 4). The model consisted of propellant, liner, an aluminum case, and cork as the external surface. The thermal properties for the above mentioned materials are listed in TABLE 2. A full cross-section of the loaded motor was created for the capability of handling non-symmetric heating/cooling.

The analysis was broken down into two phases. The first phase consisted of heating a cold conditioned motor, while the second phase consisted of cooling a hot conditioned motor. The ID surface of the propellant for both phases was assumed to be adiabatic.

The analysis for the first phase assumed that the initial temperature of the loaded motor to be at 30°F. The external boundary conditions consisted of solar radiation, free convective heating and radiative heating with the surroundings. This phase of the analysis was further broken down into three sub-phases based on an air temperature of 105°F, 85°F, and 65°F. The changes in the three air temperatures are reflected in the convective and radiative heating to the surroundings. The solar radiation, however is unaffected by the air temperature. The following assumptions were made in determining the solar heat flux:

1. The hour angle was assumed to be zero, i.e. the time is solar noon.
2. The month is May, when maximum insolation occurs (Reference 1).
3. The solar azimuth angle was assumed to be zero. In other words, the external surface of the motor case faces directly into the sun.
4. The local insolation was applied equally to quadrants 1 and 2, the top half of the motor, but was adjusted as a function of the tilt angle. The tilt angle being defined as the angle between the surface normal and the horizontal.

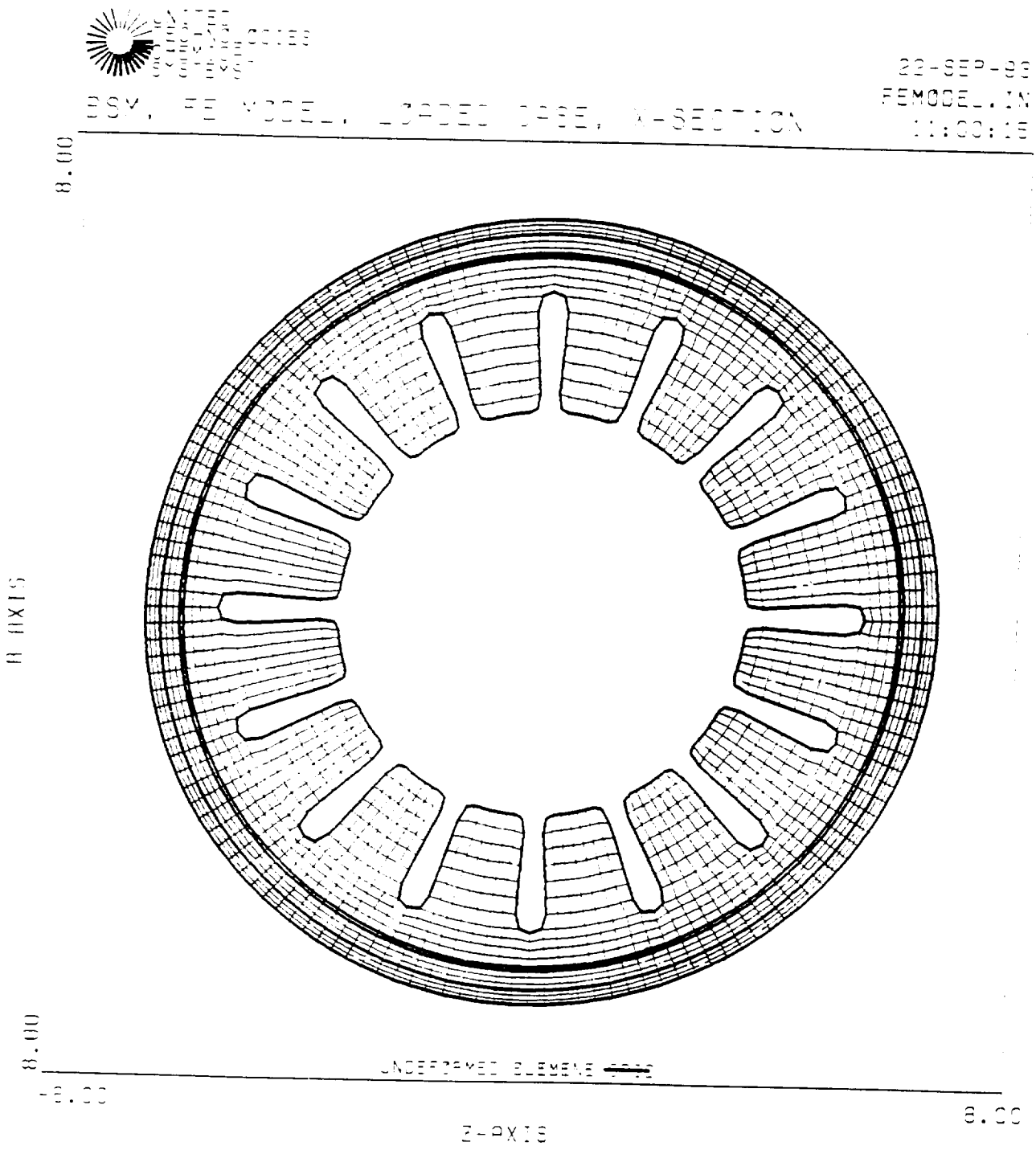


Figure 3. Finite Element Model

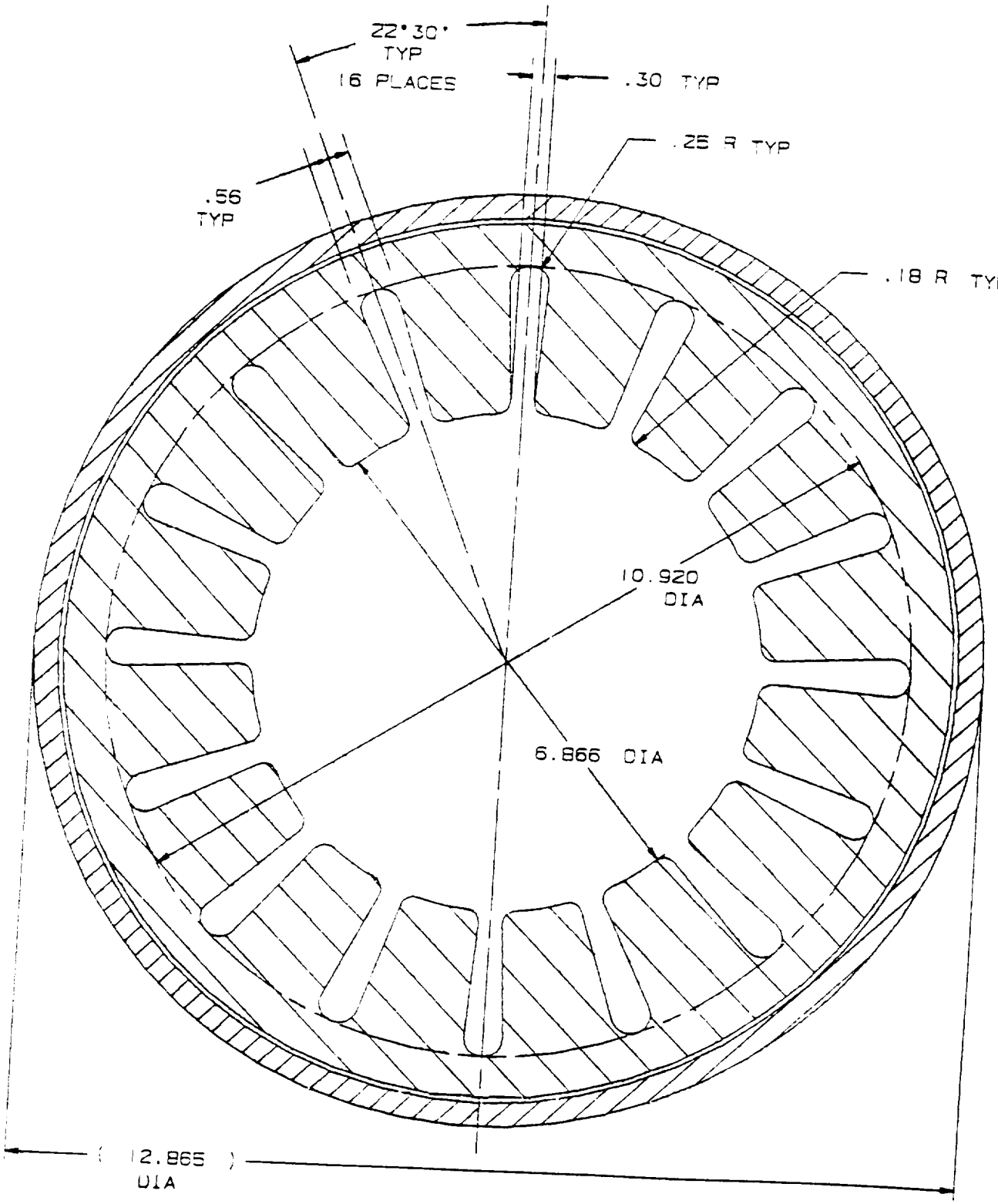


Figure 4. Cross-section, loaded case

The above assumptions gives the worst possible local solar radiation heat flux for the summer months. Chapter 27 of Reference 1 was used as the basis for calculating the local incident solar radiation heat flux. The local incident solar heat flux was calculated using the following equation:

$$I_{\theta} = I_{DN} \cos \theta$$

where:

I_{DN} = direct normal solar flux
θ = angle of incidence between incoming solar rays and line normal to the surface.

The direct normal solar flux was calculated with the following equation:

$$I_{DN} = \frac{A}{\exp\left(\frac{B}{\sin \beta}\right)}$$

where:

A = apparent solar radiation at air mass=0, (TABLE 1)
B = atmospheric extinction coefficient (TABLE 1)
β = solar altitude above the horizontal (degrees)

The solar altitude, β, is calculated as follows:

$$\sin \beta = \cos L \cos \delta \cos H + \sin L \sin \delta$$

where:

L = Latitude (37.25° CSD location)
δ = solar declination (TABLE 1)
H = hour angle (=0, solar noon)

Based on the above equations, the direct normal solar flux was calculated to be 285.06 BTU/hr-ft^2. The angle on incidence, θ, was calculated using the following equation:

$$\cos \theta = \cos \beta \cos \gamma \sin \Sigma + \sin \beta \cos \Sigma$$

where:

β = solar altitude
γ = surface solar azimuth (=0, facing directly into the sun).
Σ = tilt angle of the surface.

The tilt angle was calculated for each of the external finite element surface that was exposed to the solar heat flux and inputted into the 2-D finite element heat transfer code as a multiplication factor, with the direct normal solar flux inputted

as the source flux. The external surface of the cork was assumed to be covered with white paint. The solar absorptivity and solar emissivity for white paint was assumed to be 0.33.

Radiative flux, due to the surroundings, was applied on all the external surface elements. The source temperature for thermal radiation was assumed to be the same as the air temperature. The white paint was assumed to have an absorptivity and emissivity value of 0.81.

Convective heat transfer was applied on all external surface elements. A heat transfer coefficient of 3 BTU/hr-ft^2-°F was used, simulating a very windy day. The air temperature was used as the source temperature for heating the cold motor.

The external boundary condition for the second phase, out-of-conditioning for the hot conditioned motor ($T_{initial}$=130°F), used the same boundary conditions that was discussed above for the first phase except that no solar heat flux was applied to the external surface of the motor.

Figure 1 shows the mean bulk temperature history of the propellant for the out-of-conditioning cold motor ($T_{initial}$=20°F). The figure shows that the worst case occurs when the air temperature is at 105°F. The mean bulk temperature of the propellant will reach 25.5°F at 30 minutes which is still within the specification limit of 30°F maximum.

The results for the out-of-conditioning hot motor ($T_{initial}$=130°F) are shown in Figure 2. The figure shows that the worst case occurs when the air temperature is at 45°F. The mean bulk temperature of the propellant will reach 124.8°F at 30 minutes which is also within the specification limit of 120°F minimum.

I. Lizardo x4349
Aerothermal

TABLE 1
Solar Constants
(From Reference 1)

Month	Declination (degrees)	A (BTU/hr-ft²)	B
JAN	-20.0	390	0.142
FEB	-10.8	385	0.144
MAR	0.0	376	0.156
APR	11.6	360	0.180
MAY	20.0	350	0.196
JUN	23.45	345	0.205
JUL	20.6	344	0.207
AUG	12.3	351	0.201
SEP	0.0	365	0.177
OCT	-10.5	378	0.160
NOV	-19.8	387	0.149
DEC	-23.45	391	0.142

TABLE 2

THERMAL PROPERTIES

PROPELLANT

Density = 0.0649 lbm/in^3

Temperature (°F)	K (BTU/min-in-°F)	Sp. Ht. (BTU/lbm-°F)
0.0	3.652E-4	0.298
100.0	3.652E-4	0.298

LINER

Density = 0.044092 lbm/in^3

Temperature (°F)	K (BTU/min-in-°F)	Sp. Ht. (BTU/lbm-°F)
0.0	2.333E-4	0.361
84.0	2.333E-4	0.361
131.0	2.264E-4	0.380

ALUMINUM CASE

Density= 0.101 lb/in^3

Temperature (°F)	K (BTU/min-in-°F)	Sp. Ht. (BTU/lbm-°F)
0.0	0.1218	0.193
77.0	0.1248	0.202
100.0	0.1260	0.204
200.0	0.1302	0.213

CORK

Density= 0.0177 lbm/in^3

Temperature (°F)	K (BTU/min-in-°F)	Sp. Ht. (BTU/lbm-°F)
0.0	5.556E-5	0.470
400.0	5.556E-5	0.470

AVOID VERBAL ORDERS

To: *T. V. O'Hara*

From: *B. S. Hammond*

Cc: *R. C. Russell*

Subject: *BSM Thermal Analysis*

Date: *1 October 1993*

File: *BH-099-93*

Tim Hopper called back this morning and said "please hold our formal response for a few days which will allow USBI analytical people to review Mr. Lizardo's letter. Furthermore, the faxed letter is being viewed by USBI as compliance to our agreed 1 October 1993 submittal date."

R. C. has no problem with this issue from a Contracts perspective after I explained the situation to him.

So, CSD is to wait for USBI to review/comment on Lizardo's letter, return comments or concerns to CSD, CSD to make changes if necessary or submit the letter formally.

ATTACHMENT C

04AM CSD ENGINEERING 02

NTERNAL
ORRESPONDENCE

UNITED
TECHNOLOGIES
CHEMICAL
SYSTEM

O: L. MURPHY

M: I. LIZARDO

: BSM TEMPERATURE CONDITIONING, UPDATE (COLD MOTOR)

C: R. HAMMOND, P. MELIA, W. HUFFERD, H. ZITZER, T. O'HARA

.: October 15, 1993

: IJL-14-93E

EF: 1) Internal Correspondence, I. Lizardo to L. Murphy, "BSM Temperature Conditioning", Sept. 30, 1993, IJL-11-93E.

e two-dimensional heat transfer model, used in predicting the in bulk temperature of the propellant for the cold motor, was dated by an additional heat flux source and the removal of an tra heat loss term. The corrected plot is shown in Figure 1.

ie additional heat flux added to the model was the reflected olar heat flux from the ground. This flux was applied to the ttom half of the motor. The additional heat flux was calculated om an assumed albedo value of 0.30, a calculated incident heat lux (direct normal solar flux, I_{DN}, Reference 1), and a solar sorptivity value of 0.33 for the white paint. In other words

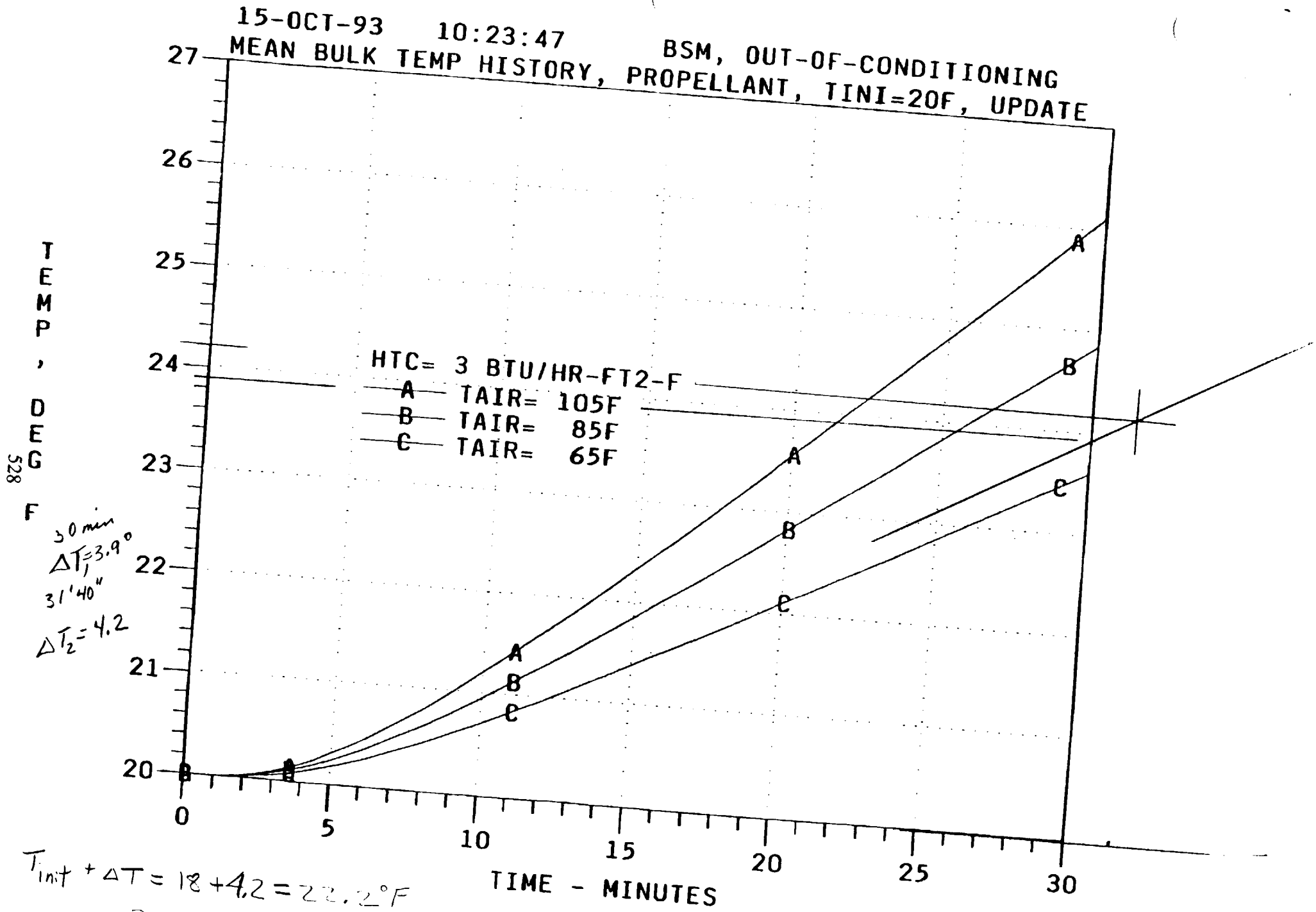
Heat Flux = $\alpha_{\text{white paint}}$ * albedo * direct normal solar flux

correction was also made to the model. The present model had vo heat loss term:

1) heat loss1 = $\sigma\, \epsilon_{\text{wall, low temp}}\, T^4_{\text{wall}}$

2) heat loss2 = $\sigma\, \epsilon_{\text{wall, solar}}\, T^4_{\text{wall}}$

ie first heat loss term (with the low temp emiss=0.81) above was plied to the entire motor. The second heat loss term (solar miss=0.33) above, which was applied to the top half of the tor, should not have been included. The corrected current model minated the second heat loss term above.


15-OCT-93 10:23:47
BSM, OUT-OF-CONDITIONING
MEAN BULK TEMP HISTORY, PROPELLANT, TINI=20F, UPDATE
HTC= 3 BTU/HR-FT2-F
A TAIR= 105F
B TAIR= 85F
C TAIR= 65F
TEMP, DEG F
TIME - MINUTES
27
26
25
24
23
22
21
20
0
5
10
15
20
25
30
A
B
C
528
30 min
ΔT1=3.9°
31'40"
ΔT2=4.2
Tinit + ΔT = 18 + 4.2 = 22.2°F
Req = 20↔22°F

INTERNAL CORRESPONDENCE

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

to *L. Murphy*

fm *P. Melia*

cc *W. Hufferd*

re *BSM Plating Flake Heating Analysis*

dt *March 18, 1993*

no *PFM-07-93-E*

A thermal analysis was performed to evaluate the heating of a thin layer of plating removed from the adaptor at the narrow annular region around the igniter base. The new plating is a 0.2 to 0.4 mil zinc/nickel alloy in the ratio of approximately 85/15. The previous plating was a 0.3 to 0.5 mil cadmium layer. The melting point of cadmium is 610 F, that of zinc is 788 F. Allowing for alloying effects suggests that melting points of about 600 and 700 F, respectively, will be representative of the cadmium and zinc/nickel alloy platings.

Previous thermal analyses, as well as test experience, indicate that both these temperatures are reached during motor operation. The present analysis addresses the heating of the removed layer as it transitions the motor.

THERMAL MODEL ASSUMPTIONS:

- 1D modeling
- .0004 inch "flake" heated from both sides (except as noted)
- convective and radiative heating
- surface absorptivity varied 0.3 to 0.6
- flake velocity equal to half chamber gas velocity
- gas velocity goes from zero at forward end to M = 0.04 at aft end
- flake residence time in chamber approximately .06 seconds, in nozzle less than .001 seconds
- Bartz heat transfer correlation for HTC, (a somewhat arbitrary model but it has a small effect)
- radiation from AL_2O_3 correlation
- initial flake temperature equals 700 F (except as noted)
- nickel properties used as reported for room temperature with estimated perturbed values at higher temperatures (K, Cp, density).

In the course of the analysis, it became apparent that, under best estimate assumptions of absorptivity, all of the flake vaporizes abruptly at some point in the chamber. However, under the assumption of worst case, low heating estimate of lowest possible flake absorptivity, the temperature is above the normal boiling point but does not produce a vapor pressure greater than local total chamber pressure. Since the generated pressure of the metal vapor is thus far, far above the partial pressure of the metal in the product species gas, there is a significant tendency for diffusive loss of material from the surface. It is difficult to predict these "evaporation" rates analytically and so an alternative evaluation criteria was used.

The particle residence time in the nozzle is so short (order of 0.001 seconds) that little additional heating occurs. The static pressure drops very rapidly however, and reaches the vapor pressure of the flake at which time the whole flake vaporizes. Thus, the mechanism for abrupt vaporization of the flake can occur two ways. In the chamber, the flake temperature rises until the metal vapor pressure equals the chamber pressure. In the nozzle, the local pressure drops until it reaches the vapor pressure of the flake at chamber temperatures.

The temperature gradients within the tiny flake are so small (about 0.001 degree) that essentially all the zinc is lost at once, suggesting that breakup of the flake is likely at this point, although not considered in the model.

THERMAL ANALYSIS RESULTS

An initial baseline thermal model was run that was felt to be conservatively low in predicting temperature of the flake. Several parametric variations were also run to determine the sensitivity of the model to the basic assumptions. These are each represented by a transient temperature history plot, figures 1 through 5, and summarized in table I.

The baseline conservative predicted response is shown in figure 1. Even in this conservative model, the flake exceeds the one atmosphere boiling point of zinc halfway down the chamber. Because the temperature gradients are small and flake sizes small, material properties have little effect. Most common metal properties give results within 10% of those quoted.

Although no model was made for a cadmium flake, it's response would be very similar. The cadmium flake would melt off at only 600 instead of 700 F, but would also boil about 250 degrees cooler so that the vaporization for the slightly thicker cadmium flake would occur at about a comparable region within the chamber or nozzle. This would be true even if the actual absolute velocities and heating rates differ from those in the present model. The main difference is that only 85% of the zinc alloy vaporizes at this point leaving a 15% residue as initially solid nickel that is likely to melt later in the chamber.

Figure 2 shows that the results are not greatly changed even if the alloy flake comes off immediately upon ignition at room temperature for some assumed but unidentified reason.

Radiation is the principle mode of heat transfer and remains so unless the flake velocity is assumed to be so small that the residence time becomes very long in which case everything goes to vapor at chamber stagnation temperature. This causes the flake surface absorptivity and emissivity to be the principle uncertainty in the model. A conservatively low value of 0.3 was used for each of these in the first two runs. When a more realistic value of 0.6 was used, the final temperature came out over 1000 degrees higher as shown in
figure 3.

The principle remaining uncertainty was whether the effects of a large flat flake "rolling up" into a ball or else "breaking up" into many pieces would change the transient temperature history significantly. These possibilities were evaluated and shown in figures 4 and 5, respectively. The roll up model assumed a flake ten times as wide as thick, i.e., 0.004 by 0.004 by 0.0004, would roll up into a sphere. A model with the equivalent resultant surface-to-volume ratio was then run and shown to reach 2728 instead of 2891 F (for absorptivity left at the value of 0.6). A much smaller size "broken up" piece was also run and found to reach 3015 F. Both of these models assumed the thicker, or else the smaller, piece of material started at time zero in the larger or smaller condition. Still the effect on final temperature was small.

CONCLUSIONS

1. Surface absorptivity of the molten alloy is the principle uncertainty but does not change the overall conclusion about vaporization of the flake.

2. Radiation is the dominant heat transfer.

3. Convection is a minor effect.

4. Thermal gradients within flake are negligible.

5. Shape, and to a considerable degree, size of the flake or particle do not have a strong effect on temperature response.

6. Other material thermal properties (K, Cp, density) are not critical.

7. Initial flake temperature has little effect.

8. "Rollup" or "break up" of flake do not change temperature history greatly.

9. Flake residence time is a significant factor but, again, generally does not change the conclusions about characteristic vaporization of the zinc and cadmium and non-vaporization of the nickel. The exceptions would be if the flake velocities are made either very low, in which case everything vaporizes, or very nearly equal to the gas velocity, which usually requires that the particles be reduced to sizes more nearly equal to those of the aluminum and aluminum oxide fuel particles.

The basic conclusion is that the largest flake of cadmium or zinc alloy both vaporize at the aft end of the chamber or in the nozzle or, at worst case, just past the exit plane of the nozzle. Only the worst case, least severe heating models, show the flake lasting into the nozzle, although even in these it is above the normal boiling point (vapor pressure equal to one atmosphere). The rapid pressure drop of the gas passing through the nozzle guarantees that the hot flake will flash over to vapor during the expansion. The zinc alloy leaves a residual 15% nickel behind after the 85% zinc vaporizes nearly simultaneously.

Even assuming an initial flake that is 25 times as wide and 25 times as long as it is thick, with maximum plating thickness, that survived the 85% vaporization process, and that the residual nickel somehow, even though it may be a solid not a liquid immediately after the zinc vaporization, managed to coalesce; even then only a 2 mil (50 micron) diameter particle would be produced.

Peter F. Melia, Chief
Aerothermal Analysis

ba
Atts.

Table I

SUMMARY OF THERMAL ANALYSIS RUNS

Run No.	Type Model	Initial Temperature (F)	Surface Thermal Absorbtivity	Flake T at end of chamber (F)	Comments
1	.00002" flat plate	700	.3	1807	Baseline, conservative absorbtivity
2	.00002" flat plate	70	.3	1787	Cold removal of flake
3	.00002" flat plate	700	.6	2891	Considered more typical absorbtivity, emissivity
4	Radius = .0008"	700	.6	2728	Plate-to-sphere equivalent ("roll up")
5	Radius = .0001"	700	.6	3015	Small particle ("break up")

533

Table II

PHASE TRANSITION TEMPERATURES (F)

Transition, Condition	P (psia)	Cd	Zn	Ni	Alloy
BP @ chamber P	1700	2190	2570	--	--
@ throat	900	2090	2450	--	--
@ exit plane	46	1590	1880	--	--
@ 1 atmosphere	14.7	1410	1663	4946	--
MP (independent of pressure)		610	788	2647	(Est. 700-750)

534

Notes: Boiling points (BP) based on Clapeyron-Clausius equation except for those at 14.7 psi.

Alloy melting point (MP) estimated relative to pure zinc melting point.

Figure 1

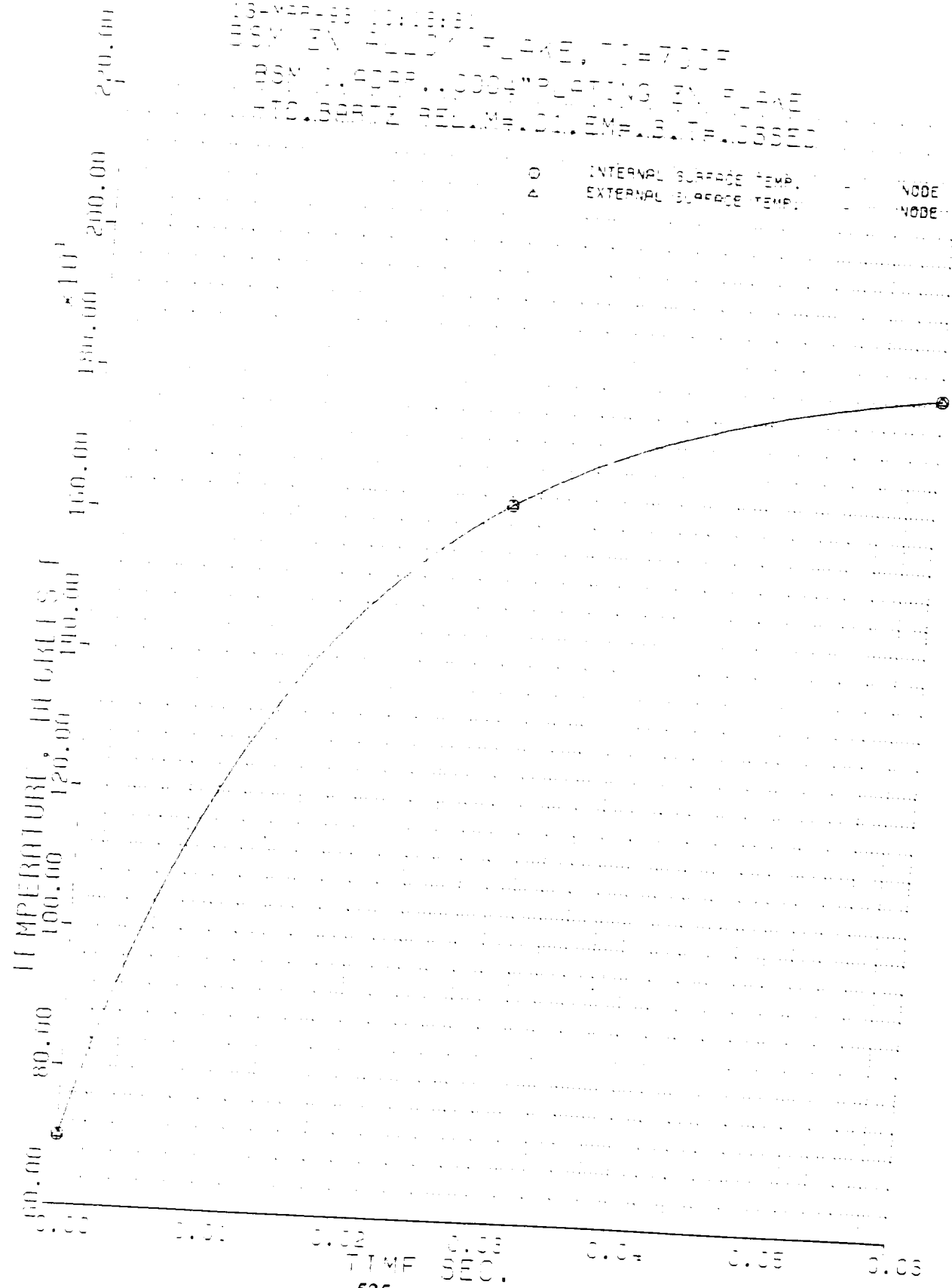

INTERNAL SURFACE TEMP.
EXTERNAL SURFACE TEMP.
NODE
NODE
TEMPERATURE, DEGREES F
TIME SEC.
80.00
100.00
120.00
140.00
160.00
180.00
200.00
220.00
0.00
0.01
0.02
0.03
0.04
0.05
0.06

Figure 2

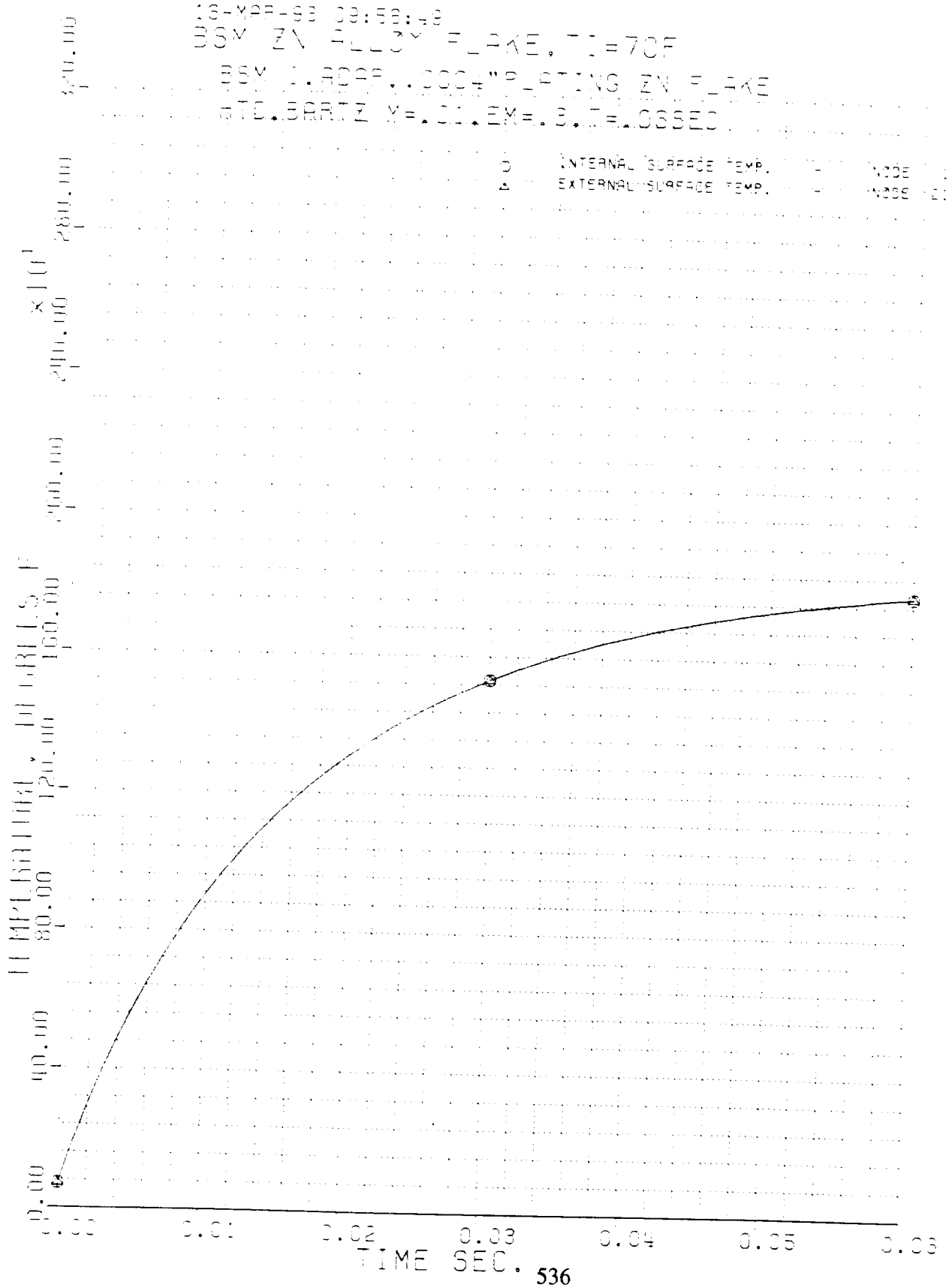

16-MAR-88 09:58:48
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BSM LOADED..0004 MPLOTTING ZN FLAKE
STD.BRRTZ M=.01,EM=.8,TE=.06SEC
INTERNAL SURFACE TEMP.
EXTERNAL SURFACE TEMP.
NODE
NODE
x10¹
2560.00
2400.00
2240.00
2080.00
1920.00
1760.00
1600.00
1440.00
1280.00
1120.00
960.00
800.00
640.00
480.00
320.00
160.00
80.00
0.00
0.00
0.01
0.02
0.03
0.04
0.05
0.06
TIME SEC.

Figure 3

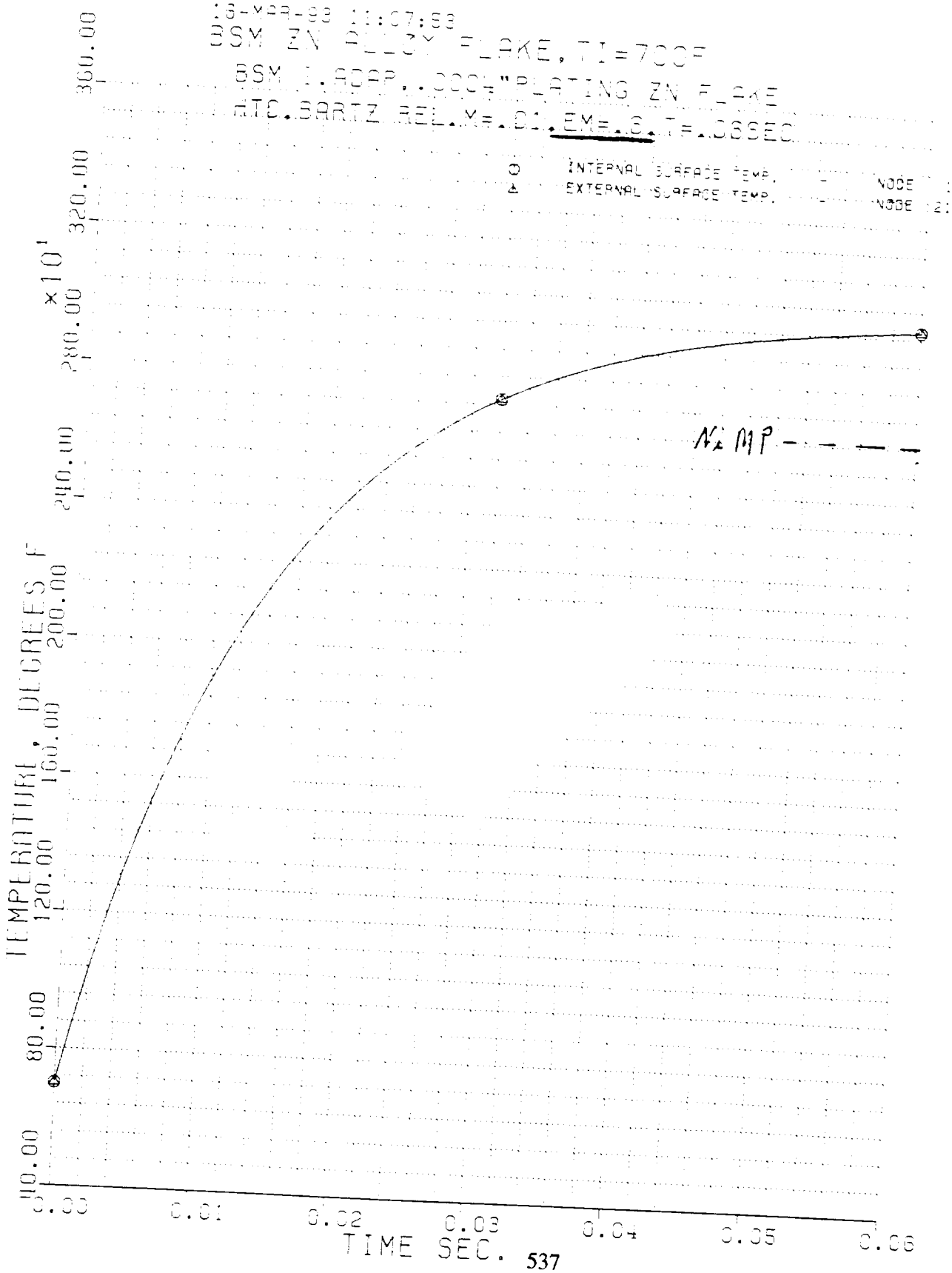

13-MAR-98 11:07:53
BSM ZN PLATE, FLAKE, TI=70DF
BSM 1.RDDP..0004"PLATING ZN FLAKE
ATC.BARTZ REL.M=.01.EM=.8.TF=.05SEC
INTERNAL SURFACE TEMP.
EXTERNAL SURFACE TEMP.
NODE
NODE
×10¹
360.00
320.00
280.00
240.00
200.00
160.00
120.00
80.00
40.00
TEMPERATURE, DEGREES F
0.00
0.01
0.02
0.03
0.04
0.05
0.06
TIME SEC.

Figure 4

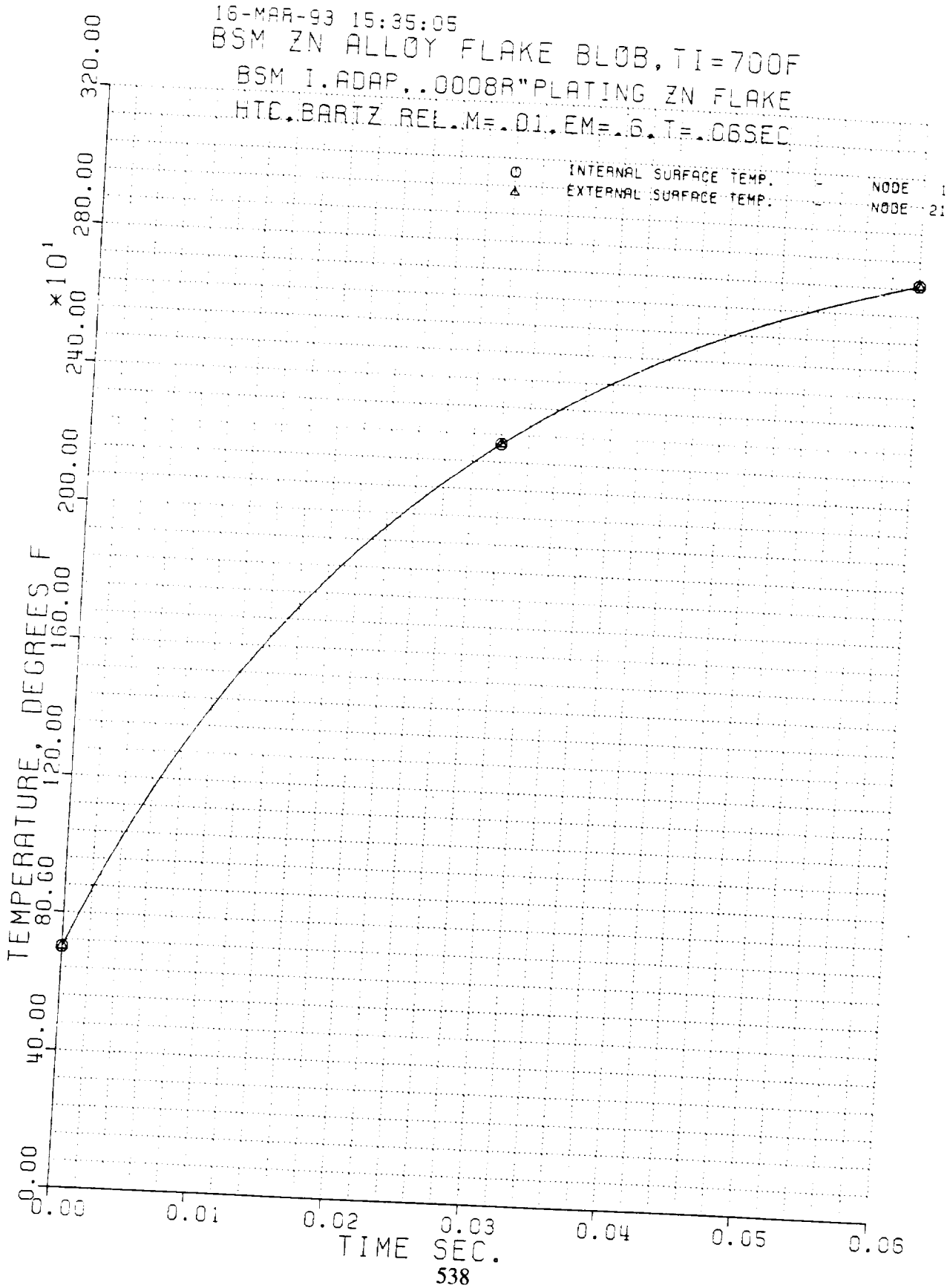
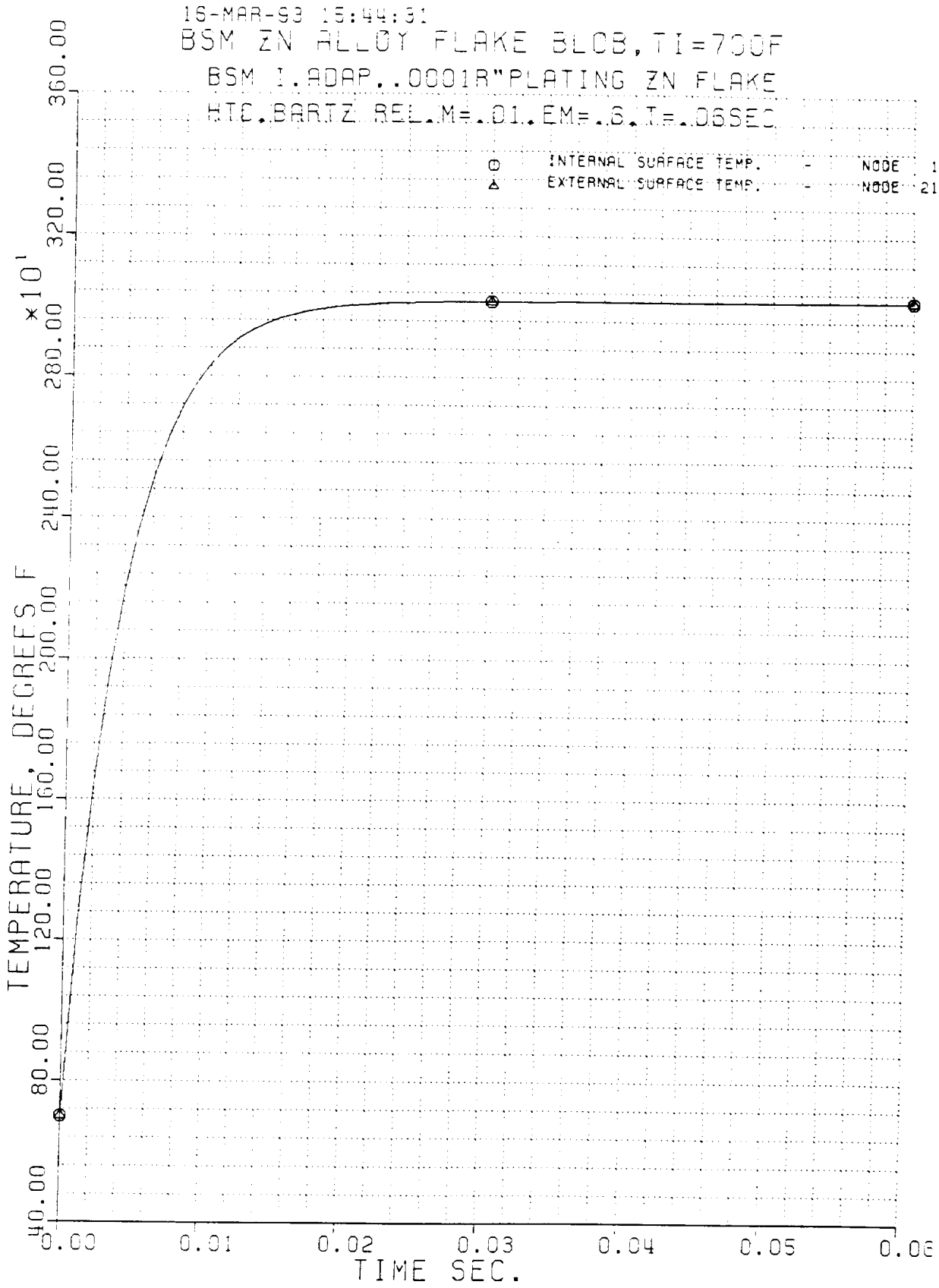

16-MAR-93 15:35:05
BSM ZN ALLOY FLAKE BLOB, TI=70OF
BSM I.ADAP..0008R"PLATING ZN FLAKE
HTC.BARTZ REL.M=.01.EM=.6.T=.06SEC
INTERNAL SURFACE TEMP.
EXTERNAL SURFACE TEMP.
NODE 1
NODE 21
TEMPERATURE, DEGREES F
*10¹
320.00
280.00
240.00
200.00
160.00
120.00
80.00
40.00
0.00
0.00
0.01
0.02
0.03
0.04
0.05
0.06
TIME SEC.

Figure 5


16-MAR-93 15:44:31
BSM ZN ALLOY FLAKE BLOB, TI=70DF
BSM I.ADAP..0001R"PLATING ZN FLAKE
HTC.BARTZ REL.M=.01.EM=.8.T=.06SEC
INTERNAL SURFACE TEMP. - NODE 1
EXTERNAL SURFACE TEMP. - NODE 21
TEMPERATURE, DEGREES F
*10¹
360.00
320.00
280.00
240.00
200.00
160.00
120.00
80.00
40.00
0.00
0.01
0.02
0.03
0.04
0.05
0.06
TIME SEC.

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TEST REPORT FOR QUALIFICATION OF REPLACEMENT SYSTEMS FOR EA913NA/L-3

DTR 5597-001
Revision NC

NOVEMBER 03, 1993



Prepared by: _____ 11-03-93
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EXECUTIVE SUMMARY

Production of the paste epoxy adhesive used to bond BSM throats and igniters (EA913NA/L-3) is being discontinued by the manufacturer. This report details the activities performed to qualify a replacement as outlined in USBI TEST PLAN FOR QUALIFICATION OF REPLACEMENT SYSTEMS FOR EA913NA/L-3, dated 3-19-93. A candidate adhesive was chosen by USBI to evaluate against the baseline material. The candidate adhesive tested is Dexter Hysol's EA9394. When tested side-by-side with the baseline EA913NA/L-3 product, the EA9394 system has proven to be an acceptable replacement material.

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1.0 INTRODUCTION

Dexter Hysol will discontinue production of EA913NA/L-3 adhesive system due to lack of availability of a key ingredient (2,4 diaminoanisole) in the liquid aromatic amine curative component L-3. This adhesive system is currently being used in BSM closure and igniter assemblies. The applicable process specification is SE1975 "Adhesive Bonding, Nozzle and Igniter Assemblies". There is no existing material specification.

A previous literature study identified 7 adhesives proposed for use in similar applications. These were ranked based on a comparison of manufacturer's stated bond strengths, pot life, viscosities, and whether materials were in full production and qualifications completed for any aerospace applications.

Of these, the dominant candidates were: Hysol's LP8801, B.F. Goodrich's EL2995, and 3M'S EC2216 B/A gray. The B.F. Goodrich products performance was acceptable but eliminated because of its limited pot life (90 minutes). 3M's product was eliminated because of its slightly lower shear strengths and limited (90 minute) pot life. The Hysol LP8801 (an EA913NA base material) was CSD's choice to evaluate against EA913NA/L-3 in a side-by-side qualification test.

Test plans were drafted by CSD, USBI, and NASA to evaluate a replacement for the EA913NA/L-3 system. From these three plans, USBI created a fourth and final plan to evaluate EA9394 adhesive as the replacement material. CSD was contracted to execute this plan.

This report outlines the activities which took place as described in the USBI TEST PLAN FOR QUALIFICATION OF REPLACEMENT SYSTEMS FOR EA913NA/L-3 dated 3-19-93. CSD's Materials and Process Engineering group performed all specimen fabrication and testing activities of this exercise following practices established in the test plan and outlined in detailed work instructions. CSD quality control and resident USBI quality were present for specific operations as required by the work instructions.

2.0 TEST OBJECTIVES AND SUCCESS CRITERIA

The primary objective of this program is to qualify a new adhesive system to replace EA913NA/L-3 on the booster separation motors. The igniter ring insulator has been deleted from the motor design and the aft closure insulator bond system will be changed to a direct vulcanization process and addressed in another test plan. The testing described in this plan will qualify a replacement adhesive system for the graphite throat to the aft closure bond, the glass phenolic insert to igniter housing and igniter grain rod bonds, and the repair of the NBR

insulator to closure bond.

The success criteria was identified so that if the side-by-side testing of the new system against the old reveals "equal to or better than" results, the EA9394 material will be successful. There is no success criteria for the repair bond.

A secondary objective is to qualify a new solvent/cleaner system to replace 1,1,1 trichloroethane (TCA) and methyl ethyl ketone (MEK). The surface preparation for all bonds use one or both of the two soon to be restricted solvents. This objective will qualify an environmentally friendly cleaner to be used as a surface cleaner in preparation for bonding with the new adhesive system. The success criteria for this objective will be the success of the new adhesive system when prepared using the new cleaner(s).

3.0 TEST PROCEDURES

3.1 TEST CONFIGURATION

Three categories of specimens were fabricated for this test, Baseline, Candidate and Aging specimens. Baseline test specimens were processed for each substrate combination to represent how hardware is built today. Candidate specimens were processed identically to the Baseline specimens except the candidate adhesive system (EA9394) and two environmentally friendly cleaners (Jettacin and Reveille) were used in replacement of TCA. Aging specimens were processed identically to the candidate specimens.

The substrate combinations were isostatic molded ATJ graphite bonded to 7075-T6 conversion coated aluminum to represent the graphite throat-to-aluminum closure bond. Glass phenolic bonded to 304L passivated stainless steel specimens represent the igniter housing-to-phenolic insert and phenolic insert-to-igniter grain rod bonds. NBR rubber-to-7075-T6 conversion coated aluminum peel specimens represent the repair interfaces of the now vulcanized aft insulator to closure bond.

The substrate combinations were tested in tension (ref. ASTM D2095), with 1.5 inch diameter flatwise tensile specimen geometries, shear (ref. ASTM D3164), with single 1.0 square inch sandwich overlaps geometries, and peel (ref. ASTM D903), with 1.0 inch wide 180° peel specimens geometries.

3.2 TEST CONDITION AND ACTIVITIES

All bonding and testing operations occurred between 62 and 72°F and 48 and 64% relative humidity. Shear tensile and peel specimens were tested at 75+/-5°F and 130+/-5°F. Shear and peel specimens were soaked at 130°F for fourteen to seventeen minutes just prior to 130° testing and flatwise tensile specimens for twenty three to twenty five minutes as determined by a thermocouple assembled into the bondline of a sacrificial specimen of each geometry.

Surface preparation techniques were as follows:

BASELINE SAMPLE PREPARATION (EA913NA/L-3);

ATJ GRAPHITE: Graphite faying surfaces were hand abraded with 400 grit emery paper, then wiped with clean Rymple cloth dampened with Isopropyl alcohol.

ALUMINUM: Aluminum faying surfaces were hand abraded with 60-80 grit emery paper, then wiped with clean Rymple cloth dampened with 1,1,1 trichloroethane.

PHENOLIC: Phenolic faying surfaces were cleaned using clean Rymple cloth dampened with 1,1,1 trichloroethane, then, hand abraded with 400 grit emery paper, and then wiped dry with Rymple cloth.

STAINLESS STEEL: Steel faying surfaces were cleaned using clean Rymple cloth dampened with 1,1,1 trichloroethane.

CANDIDATE SAMPLE PREPARATION (EA9394);

ATJ GRAPHITE: Graphite faying surfaces were hand abraded with 400 grit emery paper, then cleaned with clean Rymple cloth dampened with Isopropyl alcohol, followed immediately by a dry wipe with a clean Rymple cloth.

ALUMINUM: Aluminum faying surfaces were wiped with clean Rymple cloth dampened with Jettacin cleaner followed by a clean Rymple cloth dampened with deionized water. Immediately following the water wipe a dry wipe was performed with clean dry Rymple cloth. Then the surfaces were hand abraded with 60-80 grit emery paper followed by a wiping with clean Rymple cloth dampened with Reveille cleaner. Finally, this step was immediately followed by a dry wiping of clean dry Rymple cloth.

PHENOLIC: Phenolic faying surfaces were wiped with clean Rymple cloth dampened with Reveille cleaner, followed immediately by a dry wipe with clean dry Rymple cloth. The surfaces were then hand abraded with 60-280 grit emery paper followed by a wiping with clean Rymple cloth dampened with Reveille cleaner. Finally, this step was immediately followed by a dry wiping of clean dry Rymple cloth.

STAINLESS STEEL: Stainless steel faying surfaces were wiped with clean Rymple cloth dampened with Reveille cleaner, followed immediately by a dry wipe with clean dry Rymple cloth.

NBR RUBBER: Rubber faying surfaces were wiped with clean Rymple cloth dampened with Isopropyl alcohol.

All surfaces were allowed to air dry 20 minutes minimum prior to application of adhesive but not longer than 45 minutes.

3.3 TEST SUPPORT REQUIREMENTS

All flatwise tensile, shear and peel specimens were tested on a model 1125 Instron Tensile Tester machine. A crosshead separation rate of 0.05 inches per minutes was used for all tests but the peel tests where 12.0 inches per minutes was used. A chart speed of 0.2 to 0.5 inches per minute was used depending on which crosshead speed was used. Digital digicators were used to monitor test temperatures. Humidity was monitored for ambient tests only.

4.0 SUMMARY OF RESULTS

Baseline vs. candidate aluminum-to-graphite in shear and flatwise tensile; data, from tables 1 and 2, indicate that at 75°F the two adhesives are stronger than the graphite substrate. At 130°F the candidate indicates a 7% strength decrease for shear and an undetermined change for flatwise from the 75°F data. The 130°F flatwise specimens that failed at the secondary bond do not evaluate the primary aluminum-to-graphite bond. Therefore we only know that the primary bond is greater than this data. It is suspected that the secondary bond (EA9394) for this set of specimens should have been allowed to cure longer at room temperatures. The allowed cure for this set was 4.5 days prior to testing, all other secondary bonds cured for 8 to 10 days.

Baseline vs. candidate stainless steel-to-glass phenolic in shear and flatwise tensile: data, from tables 3 and 4, indicate that at 75 deg F the candidate adhesive (EA 9394) has a 13 % shear strength increase and in flatwise tensile a 3 % decrease in bond strength. At 130 deg F, the two adhesives show the candidate adhesive exhibits a 6 % decrease in shear strength but equal in the flatwise tensile strength.

Candidate bonding NBR rubber-to-aluminum in peel; data from table 5 indicates that at 75°F there is a 42% variability between panels and at 130°F there is a 29% variability. A true representation of the surfaces on a insulator-to-closure unbond created under laboratory conditions for test specimen fabrication purposes is very difficult to reproduce. The surface preparation chosen for this evaluation was the same for the insulator-to-closure bonding operation. Because it is not practicable to abrade the surfaces of an unbond it was chosen not to abrade the rubber surface of the peel panels. It is suspected that the surface preparation of the rubber (isopropyl alcohol wipe only) was insufficient for removing release agents which may have been transferred from the press molding process. Even with the data variability, the lowest value obtained (11.6 pli) is well above the design minimum for rubber-to-aluminum bonds.

Candidate aging specimens in shear. Tables 6 and 7 have been intentionally left blank for USBI to fill in at the conclusion of each aging interval. CSD fabricated the aging specimens which USBI will age and test at their facilities.

5.0 CONCLUSIONS

Test data shows, the candidate adhesive EA9394 is equivalent to the EA913NA/L-3 adhesive. When comparing the parameters of the two systems for bond strengths in shear, flatwise tensile, and peel at two test temperatures neither system is predominately superior or inferior in any single category.

The secondary bond failures observed in the flatwise tensile specimens was contributed to an insufficient cure. As a result of this test, it should be noted that to reach greater than 2000 psi strengths, room temperature cured (coprocess lap shear panels?) specimens should see 8 to 10 days of cure minimum prior to testing. The possibility for poor surface preparation was ruled out because the secondary bond failed cohesively within the EA9394 adhesive.

Peel panel data scatter is attributed to surface preparation of the NBR rubber substrate. The only proven preparation for cleaning rubber with environmentally friendly cleaners is the technique used on "B-staged" insulator-to-closure vulcanization bonds. Peel panel variability could be reduced by utilizing Reveille cleaner and hand abrading.

Environmentally friendly solvents and the EA9394 adhesive were evaluated for qualification together in this plan. It is very difficult to discern cause of data scatter when plans contain multiple variables. Some data differences seen in this summary may be attributed to variations in cleaning processes (on relatively small pieces of material substrates), as well as adhesive variability. For example, a Reveille cleaner dry time constraint of 20 minutes minimum and 45 minutes maximum may not be optimum when fabricating laboratory test specimens in order to qualify a production scale process. When incorporating these cleaners into production it may be necessary to adjust dry times to suit the actual part geometry and process flow.

6.0 **RECOMMENDATIONS**

It is recommended that EA9394 adhesive system be used for BSM structural and nonstructural bonds as described in this test report.

APPENDIX A

Qualification Data Summary

TABLE #1
BASELINE AND CANDIDATE INDIVIDUAL DATA SUMMARY
ALUMINUM-ATJ GRAPHITE-ALUMINUM IN SHEAR

TEST TEMP °F	75		130	
ADHESIVE	EA913NA/L-3	EA9394	EA913NA/L-3	EA9394
INDIVIDUAL VALUES	563	528	657	507
	522	519	588	497
	577	498	754	477
	569	503	611	465
	579	442	661	394
	557	515	641	468
	588	528	678	510
	589	538	761	473
	634	560	636	447
	579	518	663	484
AVERAGE	576	515	665	472
STD DIV	28	31	55	34
FAILURE MODES	COH [1]	COH [1]	ADH/COH [2]	COH/ADH [3]

Notes: 1. COH = 100% cohesive within the substrate (graphite). Failures occurred near the adhesive bondline.

2. ADH/COH = Predominantly adhesive failure, between the adhesive and the aluminum, and partial cohesive, within the graphite substrate.

3. COH/ADH = Predominantly cohesive failure, within the graphite, and partial adhesive failure between the aluminum and the adhesive.

TABLE #2
BASELINE AND CANDIDATE INDIVIDUAL DATA SUMMARY
ALUMINUM-ATJ GRAPHITE-ALUMINUM IN FLATWISE TENSILE

TEST TEMP °F	75		130	
ADHESIVE	EA913NA/L-3	EA9394	EA913NA/L-3	EA9394
INDIVIDUAL VALUES	3113	4103	3282	1669
	4131	3650	2999	2264
	4244	4131	3056	1188
	2830	3622	3113	2037
	4216	3226	3022	1585
	4726	3707	2547	1443
	4103	3905	2739	2264
	4358	2801	3113	2943
	4018	2603	3339	2066
	4018	2971	2632	1868
AVERAGE	3976	3472	2984	1932
STD DIV	572	542	265	501
FAILURE MODES	COH [1]	COH [1]	COH [1]	SEC [2]

Notes: 1. COH = 100% cohesive within the substrate (graphite).

2. SEC = Secondary bond failure.

TABLE #3
BASELINE AND CANDIDATE INDIVIDUAL DATA SUMMARY
STEEL-GLASS PHENOLIC-STEEL IN SHEAR

TEST TEMP °F	75		130	
ADHESIVE	EA913NA/L-3	EA9394	EA913NA/L-3	EA9394
INDIVIDUAL VALUES	437	778	561	762
	466	744	493	547
	698	716	463	392
	661	732	554	371
	607	833	605	410
	601	771	635	354
	690	705	445	669
	672	638	604	314
	758	965	586	693
	585	535	577	692
AVERAGE	618	742	552	520
STD DIV	102	114	64	171
FAILURE MODES	ADH [2]	ADH/COH [3]	ADH [2]	ADH/ADH [4]

Notes: 1. All specimens failed near the adhesive bondline.

2. ADH = 100% adhesive failure between the adhesive and glass phenolic substrate.

3. ADH/COH = Predominantly adhesive failure, between the adhesive and the glass phenolic substrate and partial cohesive, within the glass phenolic.

4. ADH/ADH = Predominantly adhesive failures, between the adhesive and the glass phenolic substrate and partial adhesive, between the adhesive and the steel.

TABLE #4
BASELINE AND CANDIDATE INDIVIDUAL DATA SUMMARY
STEEL-GLASS PHENOLIC-STEEL IN FLATWISE TENSILE

TEST TEMP °F	75		130	
ADHESIVE	EA913NA/L-3	EA9394	EA913NA/L-3	EA9394
INDIVIDUAL VALUES	1528	1358	905	849
	1217	1556	990	821
	1641	650 [4]	1075	1217
	1387	1528	1160	962
	1415	1273	1075	1217
	1443	1528	1075	1217
	1500	1585	1075	1132
	1556	1585	1132	990
	1613	1415	962	990
	1684	1302	1104	1047
AVERAGE	1498	1459	1055	1044
STD DIV	139	124	79	148
FAILURE MODES	ADH [2]	COH [3]	ADH [2]	COH [3]

Notes: 1. All specimens failed near the adhesive bondline.

2. ADH = 100% adhesive failure between the adhesive and glass phenolic substrate.

3. COH = 100% cohesive within the glass phenolic substrate.

4. Data not included in average.

TABLE #5
BASELINE AND CANDIDATE INDIVIDUAL DATA SUMMARY
ALUMINUM-NBR RUBBER IN PEEL

PANEL#/TEST TEMP °F	1/75	2/75	1/130 [1]	2/130
ADHESIVE	EA9394	EA9394	EA9394	EA9394
INDIVIDUAL VALUES	18.9	36.6	44.9	58.6
	14.2	30.0	79.8	74.0
	12.9	24.7	91.1	51.2
	16.2	20.0	81.7	44.4
	11.6	20.0	79.2	52.9
AVERAGE	14.8	26.3	75.3	56.2
STD DIV	2.8	7.0	17.7	11.1
FAILURE MODES	ADH [3]	ADH [3]	COH [4]	ADH [3]

Notes: 1. Specimens tore (within the rubber) approx. 1/4 inch before test was stopped due to reaching maximum extension of the crosshead. These data are peak values at time test was stopped.

2. All specimens failed near the adhesive bondline.

3. ADH = 100% adhesive failure between the adhesive and rubber substrate.

4. COH = 100% cohesive, within the rubber substrate.

TABLE #6
AGING INDIVIDUAL DATA SUMMARY
ALUMINUM-ATJ GRAPHITE-ALUMINUM IN SHEAR

YEARS OF AGING	1 (1994)	2 (1995)	3 (1996)	4 (1997)
ADHESIVE	EA9394	EA9394	EA9394	EA9394
INDIVIDUAL VALUES	1			
	2			
	3			
	4			
	5			
	6			
	7			
	8			
	9			
	10			
AVERAGE				
STD DIV				
FAILURE MODES				

YEARS OF AGING	5 (1998)	6 (1999)	7 (2000)	8 (2001)
ADHESIVE	EA9394	EA9394	EA9394	EA9394
INDIVIDUAL VALUES	1			
	2			
	3			
	4			
	5			
	6			
	7			
	8			
	9			
	10			
AVERAGE				
STD DIV				
FAILURE MODES				

TABLE #7
AGING INDIVIDUAL DATA SUMMARY
STEEL-GLASS PHENOLIC-STEEL IN SHEAR

YEARS OF AGING	1 (1994)	2 (1995)	3 (1996)	4 (1997)
ADHESIVE	EA9394	EA9394	EA9394	EA9394
INDIVIDUAL VALUES	1			
	2			
	3			
	4			
	5			
	6			
	7			
	8			
	9			
	10			
AVERAGE				
STD DIV				
FAILURE MODES				

YEARS OF AGING	5 (1998)	6 (1999)	7 (2000)	8 (2001)
ADHESIVE	EA9394	EA9394	EA9394	EA9394
INDIVIDUAL VALUES	1			
	2			
	3			
	4			
	5			
	6			
	7			
	8			
	9			
	10			
AVERAGE				
STD DIV				
FAILURE MODES				

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internal correspondence

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

To: Terry O'Hara
Fm: Bruce Goldstone
Re: BSM: Structrual Margin Assessment for ATJ Material Property Comparison: Castor versus ATACMS Data Bases
Cc: L. Murphy, R. D'Onofrio, O. Morrow, B. Hufferd, S. Kamen
Dt: November 23, 1993
No: BAG-29-93-E

BACKGROUND

A review of 'new' isomolded ATJ (TS 1792) material property data from two independent characterization test activities (Castor 1988 versus ATACMS 1992) shows differences in properties that exceed typical variations for this grade of bulk graphite. The manufacturer, Union Carbide, attributes the differences in properties to a higher graphitization temperature for the later chronological lots which were the source of the ATACMS material . According to Union Carbide, the higher graphitization temperature for the ATACMS material is consistent with the noted differences in resistivity and would result in lower compressive modulus and associated strengths. Additionally, Union Carbide believes the current and future production of isostatic ATJ graphite better matches the original press molded ATJ and is consistent with the material tested in the ATACMS characterization.

Since the thermostructural analysis of the 'new' throat material was performed using the material property data from the Castor characterization, there is some concern that the material property differences for the more representative ATACMS material would result in lower margins of safety for the throat insert. The following analysis was conducted to assess the impact of the differences between the two variations of the ATJ material.

SUMMARY

Evaluation of the BSM design using the ATACMS material properties and a safety factor of 1.25 shows a margin of safety of 2.68. The BSM design significantly exceeds the design requirements.

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DISCUSSION

To set the stage for this evaluation, it should be noted that, for the BSM operating conditions, the throat insert response is almost exclusively compressive for the full duration of motor firing. The short burn time of the motor prevents the full development of a thermal gradient condition across the thickness of the throat insert, which, in this case, eliminates the backside tension characteristic of thermal shock loading. In fact, the bore surface of the throat insert at pressure tail-off (about 0.9 seconds) is only 3,000°F. Bulk graphite materials are prone to fracture as a result of tensile stresses. Since the BSM environment precludes this condition, the emphasis of this evaluation was placed on the next critical response, maximum compression on the I.D. As was discussed in an earlier analysis (Ref.1), the hoop strain at the I.D. of the insert is dominated by restrained thermal expansion of the graphite and is independent of modulus. Therefore, the hoop strain is equivalent to the free thermal expansion of the material at the associated temperature. A comparison of thermal expansion behavior of these two materials is shown in figures 1 through 3. For both the WG (hoop and radial) and AG (axial) thermal expansion data, the two materials can essentially be treated as equivalent, considering the variation in the data. Therefore, the compressive hoop strain on the I.D. of the insert will be about 0.0075 in/in.

According to the initial analysis (Ref. 2), the critical time frame for peak hoop compressive stress is just prior to motor tail-off; about 0.9 seconds. For this evaluation all available data for both tension and compression properties were reviewed. The ATACMS characterization matrix was not as complete as the test matrix associated with the Castor program, so there is not a one-to-one correspondence of all data. A comparison of the available data is shown in Table 1. The difference in the modulus data is most pronounced at 70°F, where the ATACMS material modulus was about 75 percent of the Castor material. At 5,000°F, the difference was only about 3 percent. The strength data (at 70°F) showed a similar trend, where both the with-grain (WG) and across-grain (AG) strengths of the ATACMS material was about 75 percent of the Castor strength.

COMPRESSIVE PROPERTIES

	Temp, °F	Press Molded 'Old' ATJ	Isostatic ATJ(Castor)	Isotatic ATJ(ATACMS)
E_C (psi) AG	70	0.76	1.33	1.03
	4250	0.77		1.03
	4500	0.64	1.34	
	5000	0.38	0.70	0.68
E_C (psi) WG	70	0.97	1.37	1.19
σ_C / ε_C AG (psi / in/in)	70	8600/	13245/0.0504	10037/0.0368
	5000	11500/	8625/	
σ_C / ε_C WG (psi / in/in)	70	8400/	12935/0.034	9807/0.030

TENSILE PROPERTIES

	Temp, °F	ATJ	ATJ(TS1792)	ATJ(ATACMS)
E_T (psi) AG	70	1.18	1.35	1.48
	2000	1.28	1.44	1.69
	4000	1.59	1.17	1.29
	4250	1.57		1.29
	4500	1.53	0.86	
	5000	1.47		0.57
E_T(psi) AG	70	1.70	1.43	1.63
σ_T / ε_T AG (psi / in/in)	70	2935/	4777/0.0039	4245/0.0036
	2000	2745/	6720/0.009	
	4250	4720/		6535/0.0211
	4500	5100/	7208/0.0290	
	5000	4490/		5801/
σ_T / ε_T WG (psi / in/in)	70	3355/	4438/0.0044	4326/0.0043

To assess the effect of these differences in material properties, a one-dimensional (plane strain) thermostructural was performed at the throat plane of the graphite insert. Two analyses were performed; one using the Castor test data properties and the second using a modified version of those properties reflecting the ATACMS data. Since the basic thermostructural response of the throat insert induces strictly compressive stresses, only those properties were considered. Using the three data points from the ATACMS testing, at 70, 4250, and 5000°F, an estimated compressive modulus curve was developed using a constant ratio of properties as a function of temperature. The modulus values used in the analysis are shown in figure 1. Since the WG and AG properties are nearly equal, the analysis was simplified by equating these directional properties. The temperature gradient at 0.9 seconds was used to establish a comparison with the original two-dimensional analysis.

ANALYSIS RESULTS

The results of the 1D analysis are shown in the table below.

Material Model	Hoop Stress, psi	Hoop Strain, %	
Castor	-13430	-0.00779	
ATACMS	-10880	-0.00784	
Difference	1.23	0.994	(Castor / ATACMS)

As expected the difference in hoop compressive stress on the I.D. is simply the ratio of the modulus values. As mentioned earlier, the ATACMS data, at 70°F, showed an equivalent reduction in compressive strength as the reduction in modulus, from the Castor data. If that trend holds for the full temperature range, the result would be no change in margin of safety. On the other hand, examining the hoop strain response, this analysis showed that the compressive hoop strain changed by less than 1

percent. This supports the initial assessment that the restrained thermal expansion is the primary source of loading at the insert I.D., and the induced strain is independent of modulus. Unlike the strength data, the ultimate compressive strain capability of the ATACMS material showed a fairly significant reduction from 0.0504 in/in, for the Castor material, to 0.0368 in/in. Compared to the induced strain of about 0.0080 in/in (from Ref. 1), the capability of the material still far exceeds the induced response with a margin of safety of 2.68 (FS = 1.25).

This evaluation of material properties for the replacement ATJ material shows that the BSM nozzle envirnoment is mild compared to the environments for which this grade of bulk graphite was designed. The operating characteristics of the BSM prevent the development of sufficient thermal loading to produce a thermal shock condition in the throat insert. Considering the capability of the material versus the induced response, the ample margin of safety on ultimate strain shows that any material within the range of properties (i.e. press molded ATJ, and isostatic Castor and ATACMS ATJ) of these materials is acceptable for the BSM application.

Bruce Goldstone

Bruce Goldstone, Chief
Structural Analysis

References

1. Memo, BAG-09-93-E, "Structural Analysis Assessment of Using TS1792 Graphite in the BSM Nozzle", to Larry Murphy, dated May 14, 1993.

2. Memo, SFK-34092-E, "BSM ATJ Graphite Replacement, TS1792 Graphite", to L. Murphy, dated October 13, 1992.

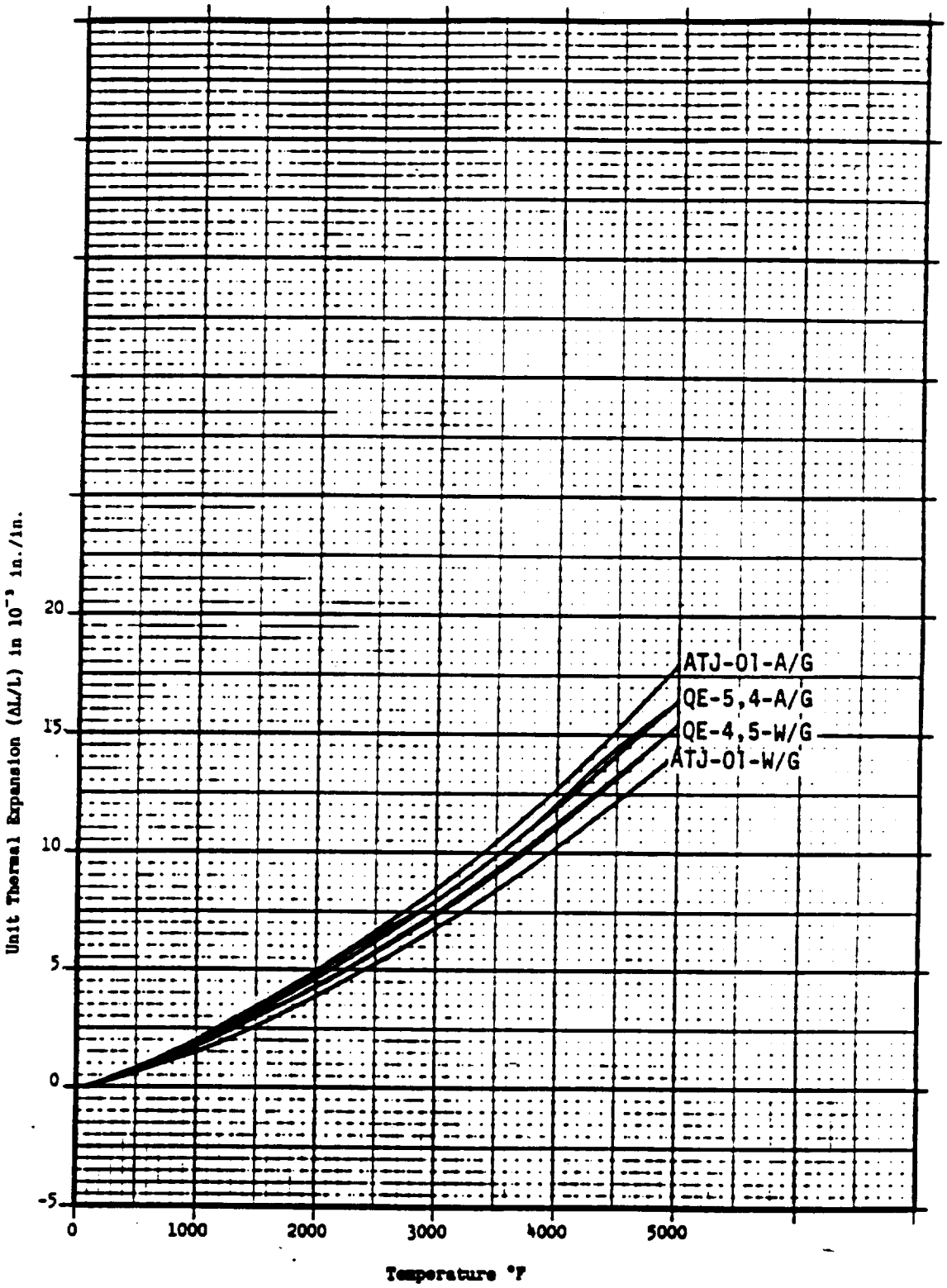


Figure 1 Comparison of Both With-Grain and Across-Grain Thermal Expansion of Billets ATJ-01, QE-4 and QE-5 from Room Temperature to 5000 °F

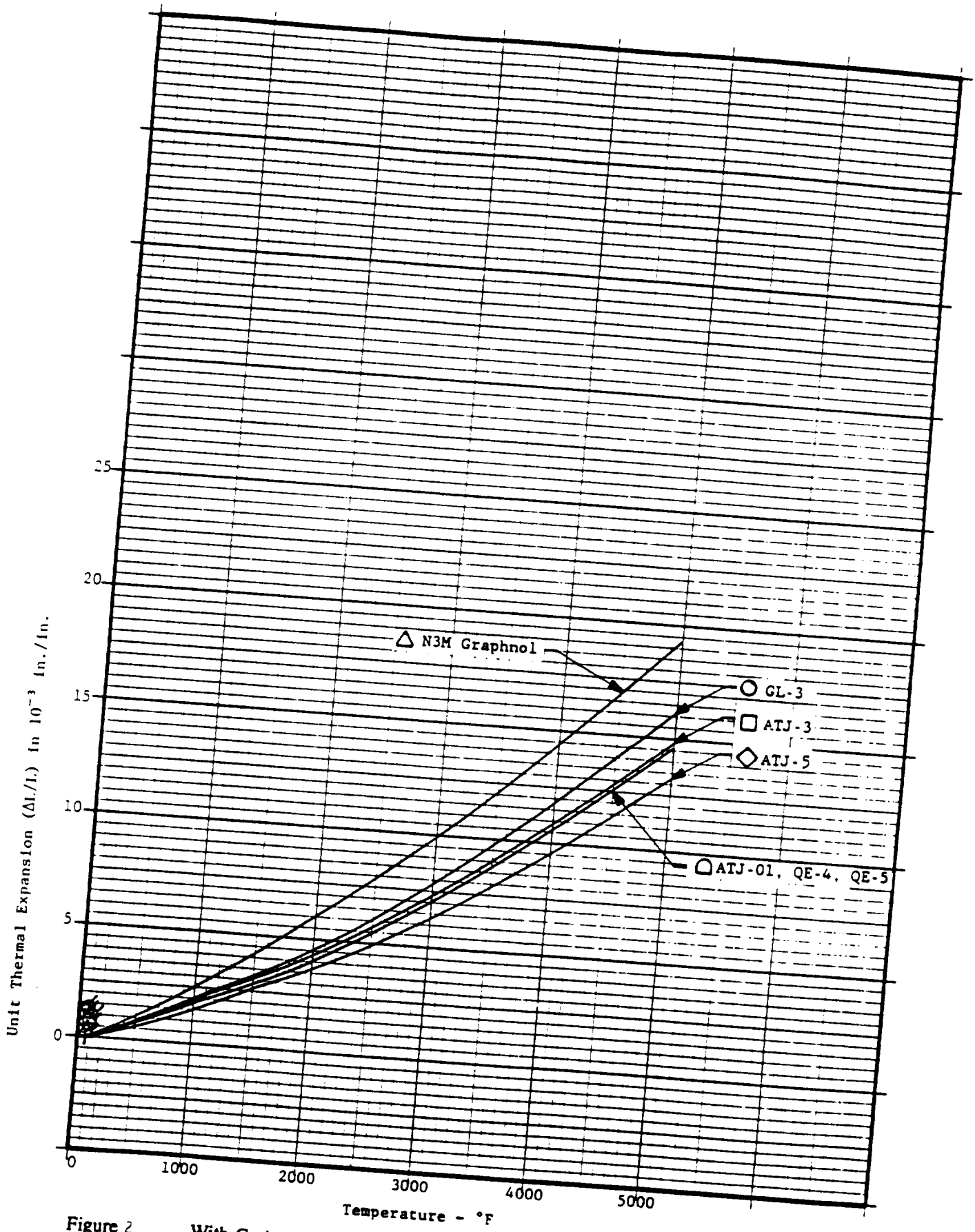


Figure 2 With-Grain Thermal Expansion Comparison of ATJ and GL Graphite to Historical Graphite and Graphnol

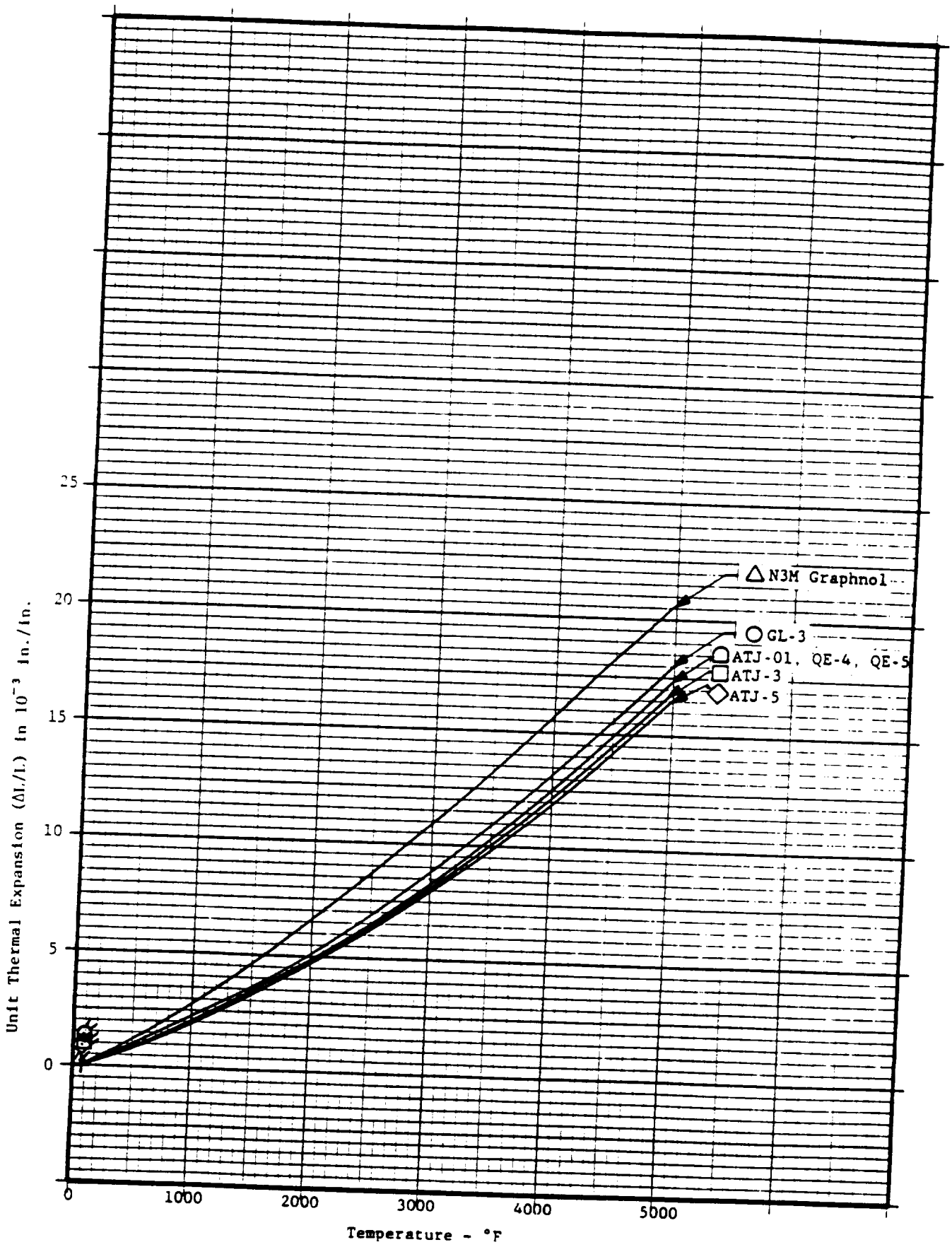


Figure 3 Across-Grain Thermal Expansion Comparison of ATJ and GL Graphite to Historical Graphite and Graphnol

internal correspondence

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

To: Larry Murphy

Fm: Bruce Goldstone

Re: Structural Analysis Assessment of Using TS 1792 Graphite in the BSM Nozzle

Dt: May 14, 1993

No: BAG-09-93-E

Cc: T.V. O'Hara, S.F. Kamen

A thermostructural analysis was conducted to assess an alternate throat insert material for the existing ATJ graphite in the BSM nozzle. The proposed material is Union Carbide's TS1792 ATJ isomolded graphite, which is their replacement for the ATJ material. The analytical methods and results for the thermostructural analyses were documented in Ref. 1. Upon review of the referenced document, the customer has requested further information regarding, (1) the use of a compressive strength that is in excess of the graphite supplier's quoted data (Ref. 2), and (2) an assessment of the impact on structural margins of safety using the vendor data. The following discussion is provided in response to that request.

For the purpose of calculating structural margins of safety, the goal is to use a material property database with the highest confidence level, preferably one having 'A' basis allowables. However, for many of the materials used in solid rocket nozzles, that level of material characterization is often not available. Therefore, the solid rocket industry has adopted a procedure for performing thermostructural analysis that suggests the use of nominal predictive properties for computing induced stresses and strains, and using 'B' basis allowables for calculating margins of safety (MS).

In the BSM application, the critical thermostructural response occurs on the ID of the throat insert, at or near the end of motor operation, when the surface is at maximum temperature. The primary state of stress on the ID surface in circumferential (hoop) compression. The following data shows a comparison of the analysis results for the existing ATJ and the alternate TS1792 ATJ graphites, and the factor of safety assessment, using the B basis allowables approach described above.

	ATJ		TS1792	
Avg. Compr. Strength, psi	10,993	(2570°F)	17,228	(3000°F)
Std. Deviation of data	713		985	
No. of Replicate tests	8		6	
K factor for 95/90	2.7		3.7	
B basis allowable, psi	8,834		13,584	
Predicted stress, psi	11,100		15,253	
Factor of safety	0.80		0.89	

The results of this analysis, using a maximum stress failure criteria, indicates that neither material is adequate for use in this nozzle application, having factors of safety below 1.0, let alone below the design requirement of 1.4. However, the analysis does show a marked improvement in capability of TS1792 over the ATJ by a factor of almost 1.8.

The fact that the existing ATJ material has flown successfully on the Space Shuttle program over 700 times, strongly suggests that the lack of sufficient data in the database produces overly conservative allowables, and/or, the failure criteria is inappropriate.

As a second approach to assessing the structural MS for the throat inserts, the vendor quoted capability at room temperature (RT) was selected as a basis for establishing the minimum capability of the material at RT, and the strength relationship with temperature was proportioned to the nominal material characterization data (Generated by Southern Research Institute). In the case of the ATJ material, the vendor data at RT was identical to the data from the SRI characterization, so no adjustments were required for the elevated temperature data. On the othernand, the TS1792 test data from SRI showed a RT capability of 12,935 psi compared to the 9,630 psi quoted by the vendor, Union Carbide; thus, the source of the original request.

As was done before, a comparison of factors of safety is shown below.

	ATJ		TS1792	
Vendor RT strength, psi	8,600		9,630	
SRI RT strength, psi	8,600		12,935	
Ratio Vendor/SRI data	1.0		0.74	
Avg. Compr. Strength, psi	10,993	(2570°F)	17,228	(3000°F)
Modified Allowable, psi	10,993		12,826	
Predicted stress, psi	11,100		15,253	
Factor of Safety	0.99		0.84	

Again, the factors of safety of both material show inadequate material capability. This time the ATJ factor shows some improvement over the TS1792. The swing in relative factors of safety between the two materials is derived from the apparent correlation of the ATJ RT strength data between the vendor and SRI. At this time there is no explanation for the difference in RT strengths for the TS1792, between the two test agencies. However, the test specimen configurations used by both vendors are quite different. Union Carbide uses a two (or one) inch cube configuration, while SRI uses a cylindrical dogbone type specimen.

The last evaluation uses only the nominal SRI data. These results are shown below.

	ATJ		TS1792	
Avg. Compr. Strength, psi	10,993	(2570°F)	17,228	(3000°F)
Predicted stress, psi	11,100		15,253	
Factor of Safety	0.99		1.12	

As with the first assessment, when the factor of safety is calculated using a consistent data source, the TS1792 shows improved capability. In this case the factor was 14 percent. The analysis, so far, shows that when evaluated on a common basis, the TS1792 shows improved performance capability over the current ATJ material, and with the demonstrated success of the ATJ material, it is expected that the alternate TS1792 material would have the same successful performance.

The task still remains to assess the margin of safety for each material. In the initial analysis of the BSM, nozzle, the maximum stress failure criteria was replaced with the Coulomb-Mohr criteria, applied to three dimensions (Ref. 3). Without the original calculations to provide as a guide, the FS were recomputed on consistent basis using the approach described in the text of the analysis. Appling that criteria to the TS1792, and, again comparing results, provides the following.

	ATJ		TS1792	
Effective Strength, psi	28,664	(2570°F)	39,573	(3000°F)
Combined Effect. Stress, psi	14,610		18,954	
Factor of safety	1.96		2.09	

In this comparison both materials have almost equivalent FS, varying by only about seven percent. The less conservative nature of this failure criteria, in this case, shows ample margin

for the successful performance of the throat insert.

As a "sanity check" to the margin assessment, the total thermal and mechanically induced strain at the throat insert ID surface was compared to the free thermal expansion of the material for the same temperature. At 3000°F, the thermal expansion of the TS1792, with-grain, is 0.0075 in/in. Compared to the total induced strain predicted by analysis, 0.0080 in/in, it's clear that the insert is in an almost completely restrained thermal growth condition. This means that the induced strain will essentially be equal to the thermal strain caused by the local change in temperature, plus whatever other mechanical strains are being imposed. Since the aluminum shell is so stiff and massive compared to the throat insert, the mechanically induced strains are negligible. Therefore, the thermal strains dominate the throat insert compressive response and provide an upper bound for the induced response. From the stress-strain behavior of the TS1792 material (Ref. 4) at 3000°F, the average strain capability was 0.070 in/in. This shows that there is a FS of over 8.0 on maximum strain. The ATJ material, on the otherhand, for basically the same thermal strain, has a failure strain capability of 0.04 in/in, which gives a FS of about 5.0.

The results of this evaluation show that bulk graphites, like ATJ and TS1792, cannot be adequately assessed using a maximum stress failure criteria for combined compression stress states, and that in order to properly assess the margins of safety, more advanced failure criteria are necessary. The combined failure criteria, as applied here, was less conservative than the earlier approach, but when used in conjunction with a linear elastic analysis still provides overly conservative results. This was evident when a practical comparison of induced versus allowable strain capability was made, which is independent of the analysis method.

The overall assessment is that the TS1792 ATJ graphite shows improved mechanical properties and capability over the existing ATJ graphite and will provide equivalent structural performance in the BSM nozzle.

Bruce Goldstone

Bruce Goldstone, Chief
Structural Analysis

References

1) CSD Memo SFK-34-92-E, "BSM ATJ Graphite Replacement, TS1792 Graphite, October 13, 1992

2) Union Carbide, Graphite Specialty Products, Technical Information Bulletin 130-201, Grade ATJ Isomolded Graphite

3) CSD 5180-76-2, Revision E, September 12, 1978, "Booster Separation Motor Stress Analysis Report"

4) SRI-EAS-88-944-6440-1-F, "Thermal and Mechanical Evaluation of Grade TS1792 ATJ Graphite Billets QE4 and QE5 Used in Castor IVA Rocket Motor", October 1988

SRI-MME-92-764-7586

MECHANICAL AND THERMAL EVALUATIONS OF ATJ AND GREAT LAKES GRAPHITE FOR ATACMS

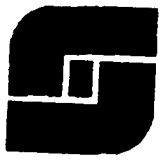
Report to

U.S. Army Missile Command
Redstone Arsenal, AL 35898-5200

Prime Contract Number: DAAH01-92-C-R204

November 1992

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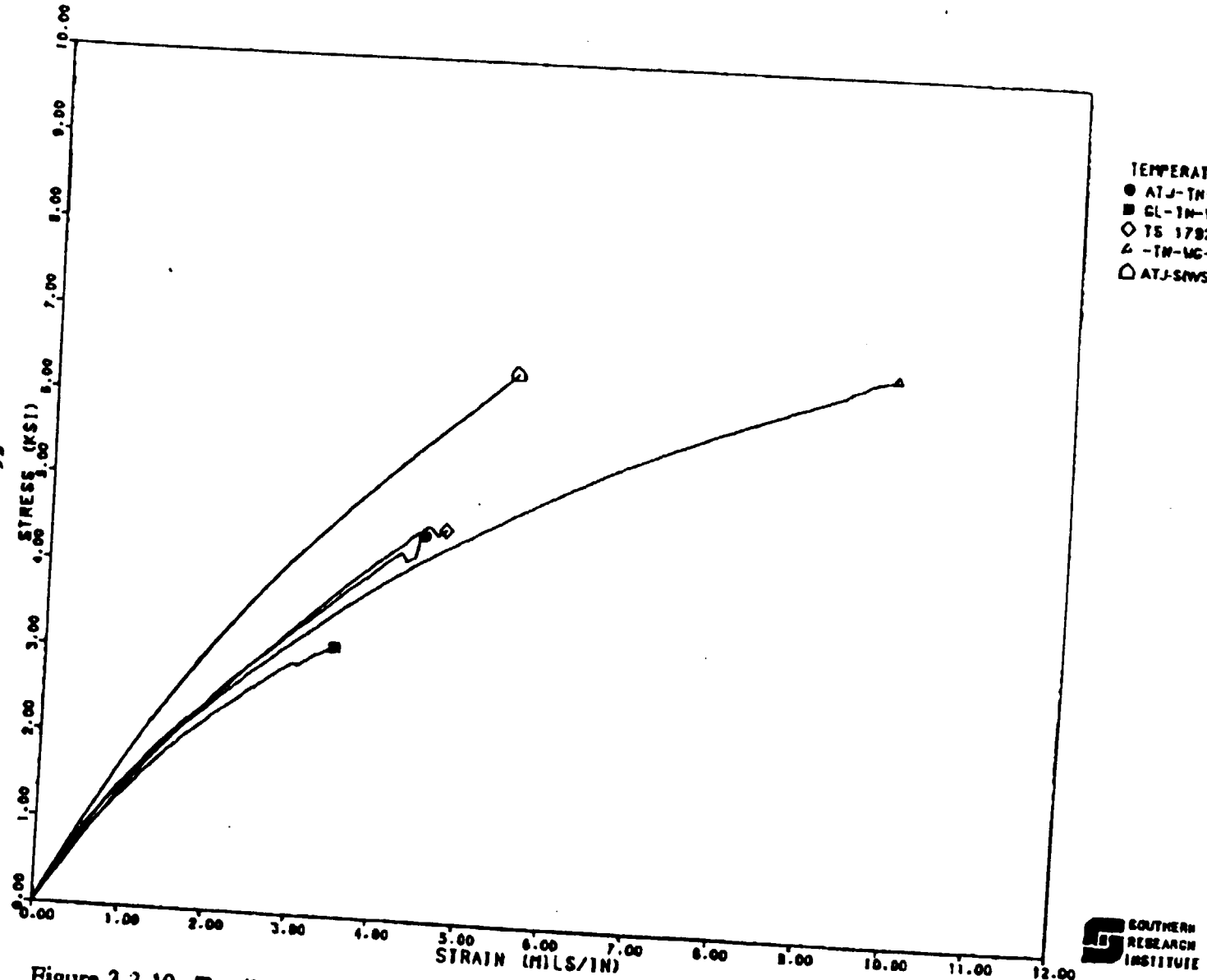


Figure 3.3-10 Tensile With-Grain Comparison of Bulk Graphite and Graphnol Materials at Room Temperature

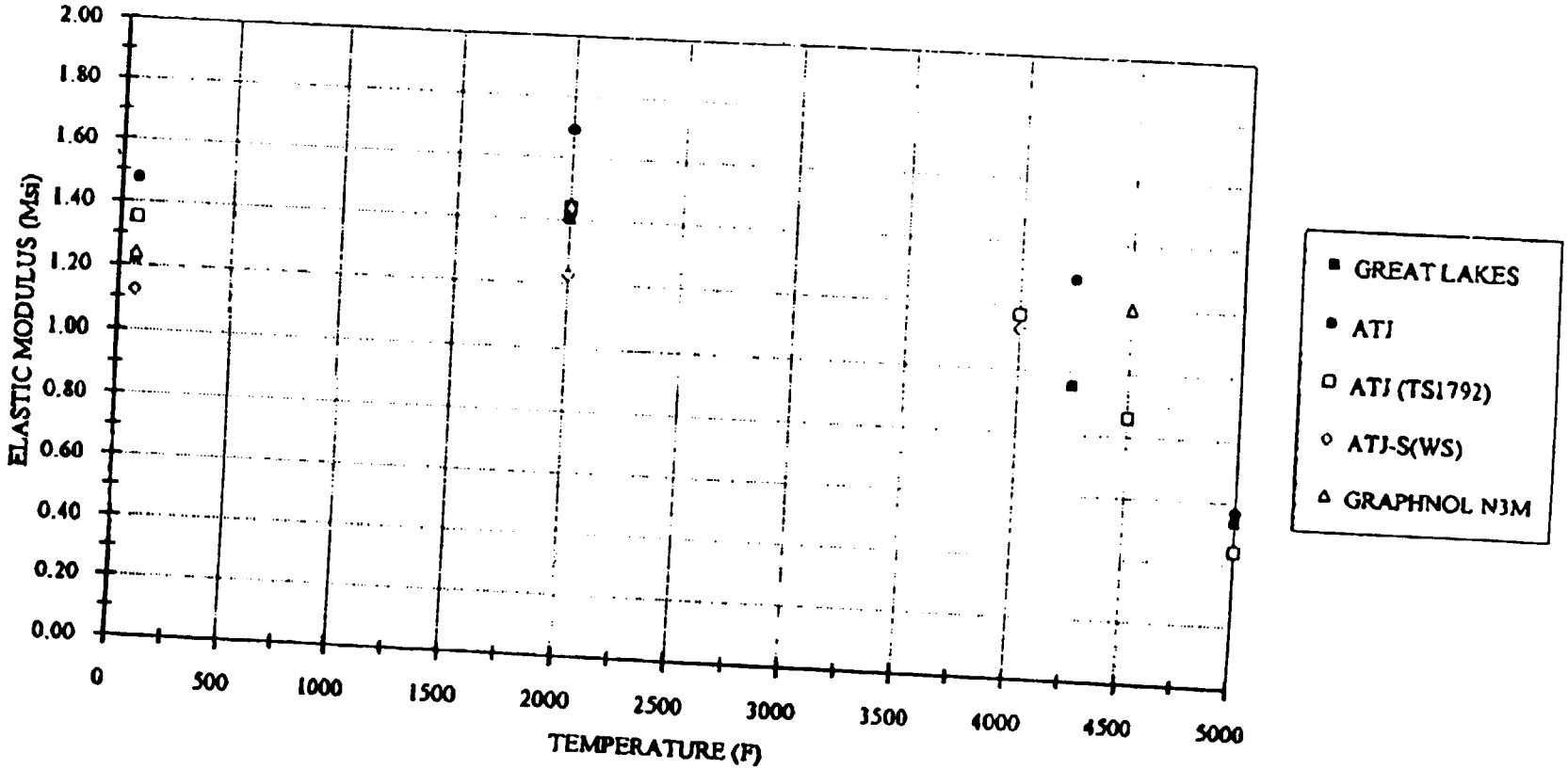


Figure 3.3-11. TENSILE ACROSS-GRAIN ELASTIC MODULUS FOR VARIOUS GRAPHITE AND GRAPHNOL

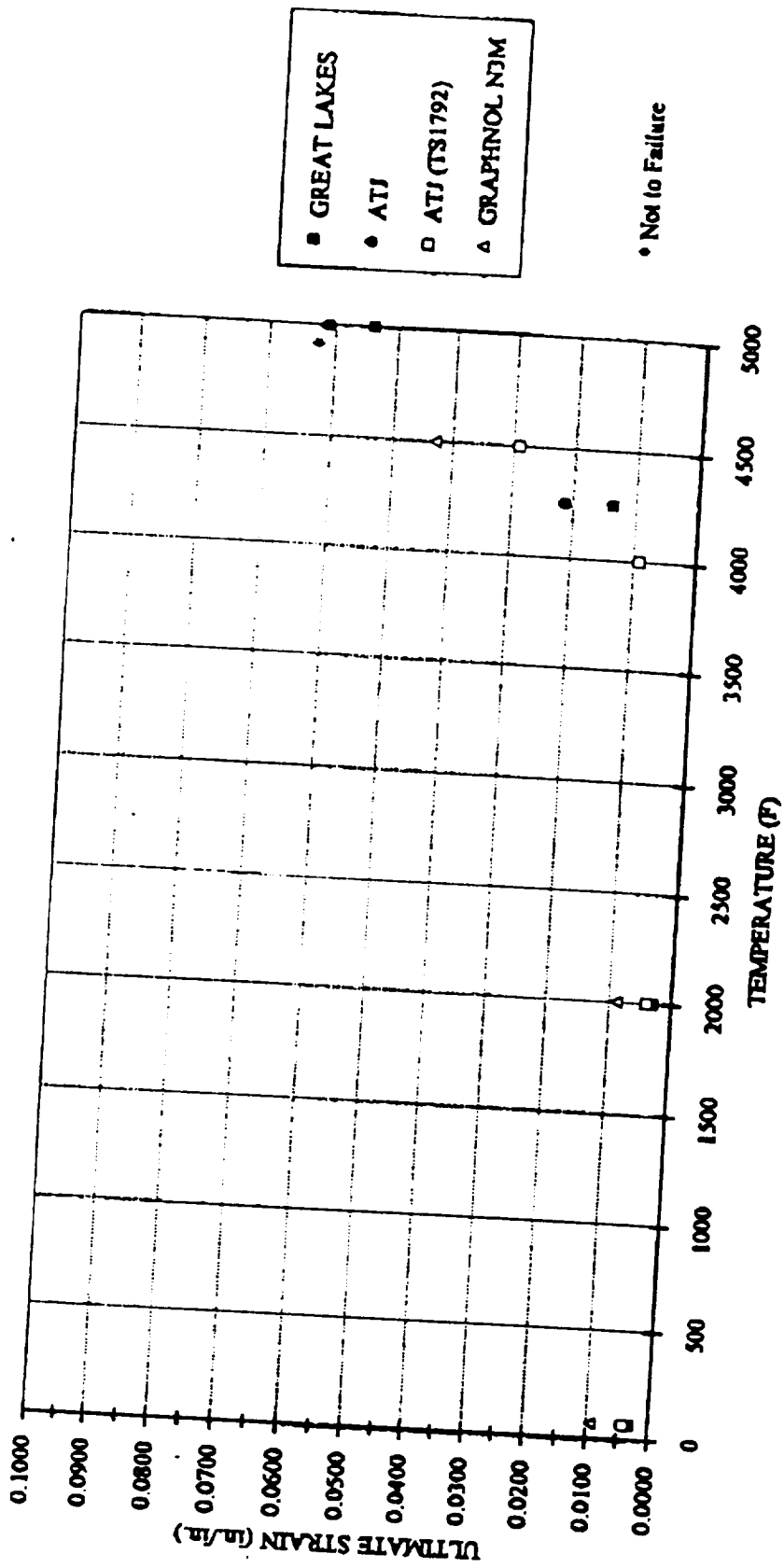


Figure 3.3-12. Tensile Across-Grain Ultimate Strain for Various Graphite and Graphnol Materials

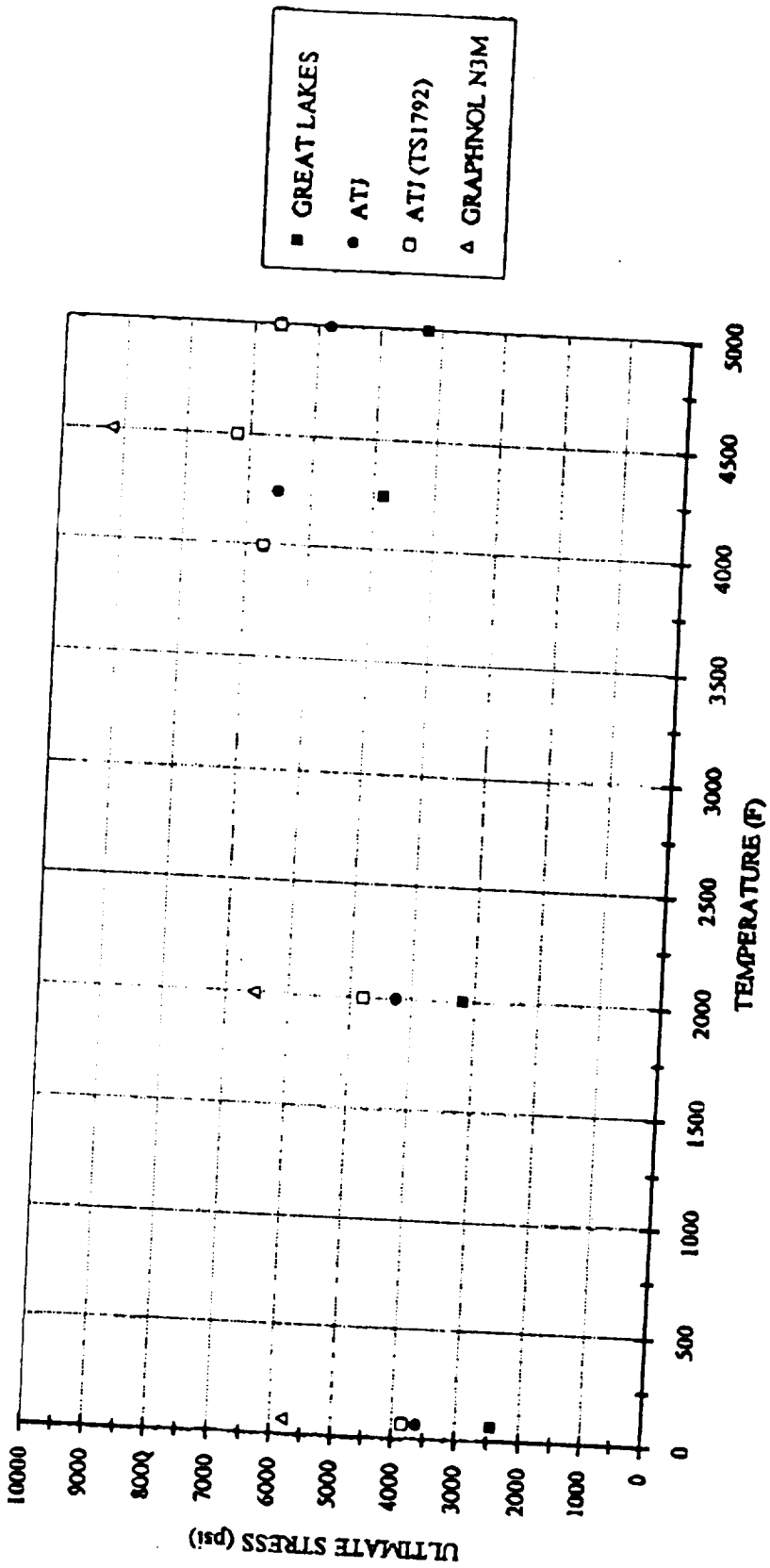


Figure 3.3-13. Tensile Across-Grain Ultimate Stress for Various Graphite and Graphnol Materials

Table 3.3-3. Summary of Tensile Stress-Strain Data for the Average Curves of Graphite and Graphnol Material

Material	Property	Orientation	Temp (°F)	Stress Rate (psi/min)	Initial Modulus (Msi)	Poisson's Ratio	Ultimate Stress (psi)	Ultimate Strain (in./in.)	Bilinear Fits to Stress-Strain Curves				
									Primary Modulus (Msi)	Secondary Modulus (Msi)	Yield Strain (in./in.)	Yield Stress (psi)	Strain Value That Fit is Extended to (in./in.)
GREAT LAKES ATJ	Tension	Across Grain	70	10000	1.23	-	2443	0.0030	-	-	-	-	-
ATJ (TS 1792)	Tension	Across Grain	70	10000	1.48	-	3620	0.0044	-	-	-	-	-
ATJ-S(WS)	Tension	Across Grain	70	-	1.35	0.12	3838	0.0040	-	-	-	-	-
GRAPHNOL N3M	Tension	Across-Grain	70*	10000	1.13	-	-	-	-	-	-	-	-
GREAT LAKES ATJ	Tension	Across Grain	2000	10000	1.24	-	5792	0.0094	1.1520	0.5930	0.0019	2177	-
ATJ (TS 1792)	Tension	Across Grain	2000	10000	1.40	-	3177	0.0029	-	0.4290	0.0027	3086	0.01
ATJ-S(WS)	Tension	Across Grain	2000	-	1.69	-	4245	0.0036	-	-	-	-	-
GRAPHNOL N3M	Tension	Across Grain	2000	10000	1.44	-	4777	0.0039	-	-	-	-	-
ATJ (TS 1792)	Tension	Across Grain	2000	10000	1.23	-	-	-	-	-	-	-	-
ATJ-S(WS)	Tension	Across Grain	4000	-	1.45	-	6550	0.0088	1.3210	0.6290	0.0029	3526	-
GREAT LAKES ATJ	Tension	Across Grain	4000	10000	1.17	-	6720	0.0090	-	0.3880	0.0035	4537	0.01
ATJ (TS 1792)	Tension	Across Grain	4250	10000	1.13	-	-	-	-	-	-	-	-
GRAPHNOL N3M	Tension	Across Grain	4250	10000	0.96	-	4839	0.0136	-	0.2990	0.0039	4360	-
GREAT LAKES ATJ	Tension	Across Grain	4500	-	1.29	-	6535	0.0211	-	-	-	-	-
ATJ (TS 1792)	Tension	Across Grain	4500	10000	0.86	-	7208	0.0290	-	-	-	-	-
GRAPHNOL N3M	Tension	Across Grain	5800	10000	1.20	-	9195	0.0430	1.1630	0.3100	0.0033	3890	-
GREAT LAKES ATJ	Tension	Across Grain	5800	10000	0.53	-	4219	0.0539	-	-	-	-	0.01
ATJ (TS 1792)	Tension	Across Grain	5800	-	0.57	-	5801	> 0.0610	-	-	-	-	-
					0.44	-	6597	-	-	-	-	-	-
GREAT LAKES ATJ	Tension	With Grain	70	10000	1.63	-	3062	0.0032	-	-	-	-	-
ATJ (TS 1792)	Tension	With Grain	70	10000	1.63	-	4326	0.0043	-	-	-	-	-
ATJ-S(WS)	Tension	With Grain	70	-	1.43	0.12	4438	0.0044	-	-	-	-	-
GRAPHNOL N3M	Tension	With-Grain	70**	10000	1.69	-	-	-	-	-	-	-	-
				10000	1.26	-	6419	0.0098	1.2110	0.9350	0.0015	2525	-
										0.4700	0.0028	3422	0.01

* Average across-grain Poisson's ratio = 0.006

** Average with-grain Poisson's ratio = 0.140

MATERIAL	PROJECT
ATJ (TS 1792)	6440
ATJ-S (WS)	2220
Graphnol N3M	3667-3

577

SRI 205*581*2414-408 776 4444 ; 7-93 ;10:13AM ; # 7

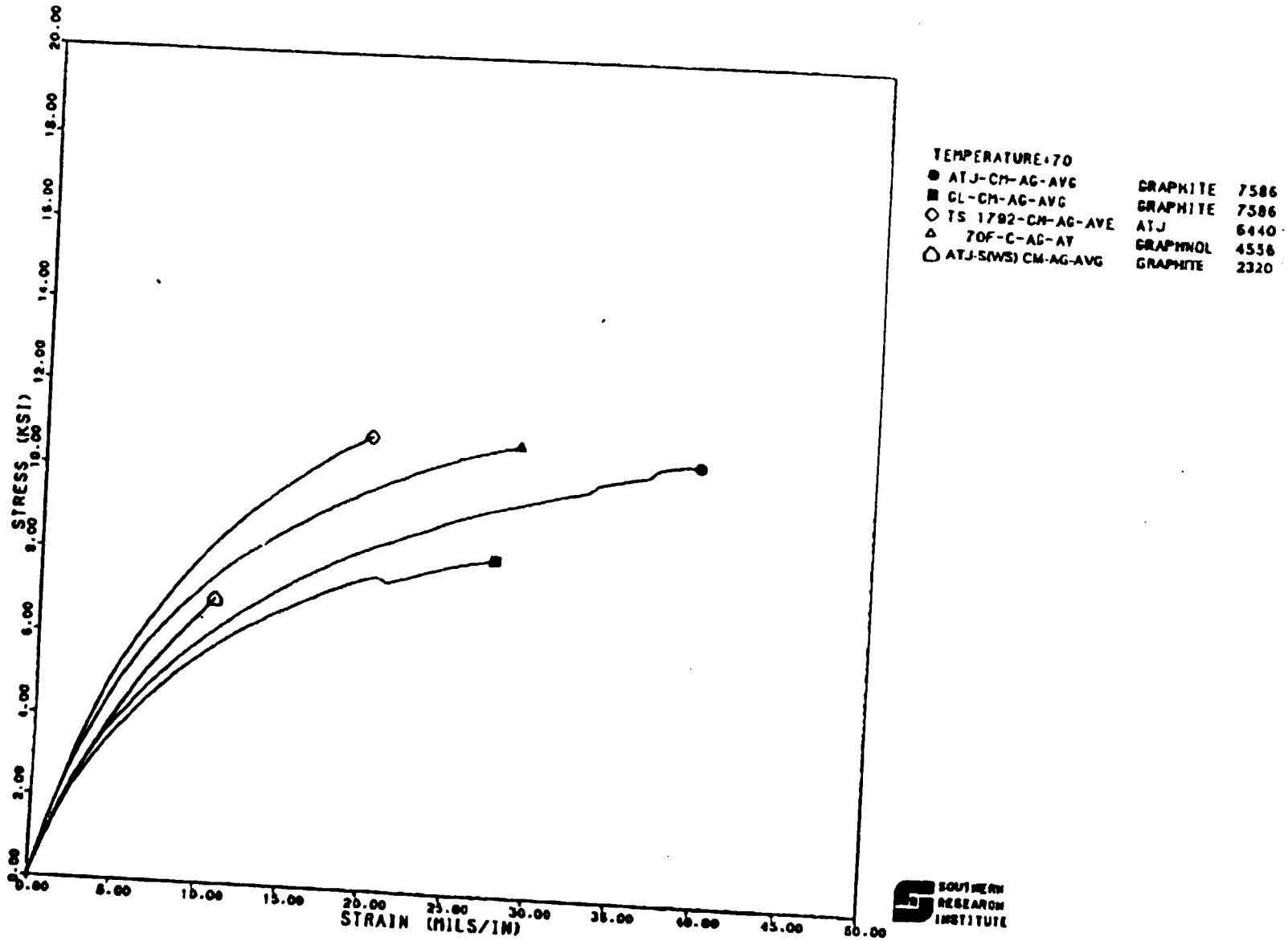


Figure 3.4-5. Compressive With-Grain Comparison of Bulk Graphite Materials at Room Temperature

578

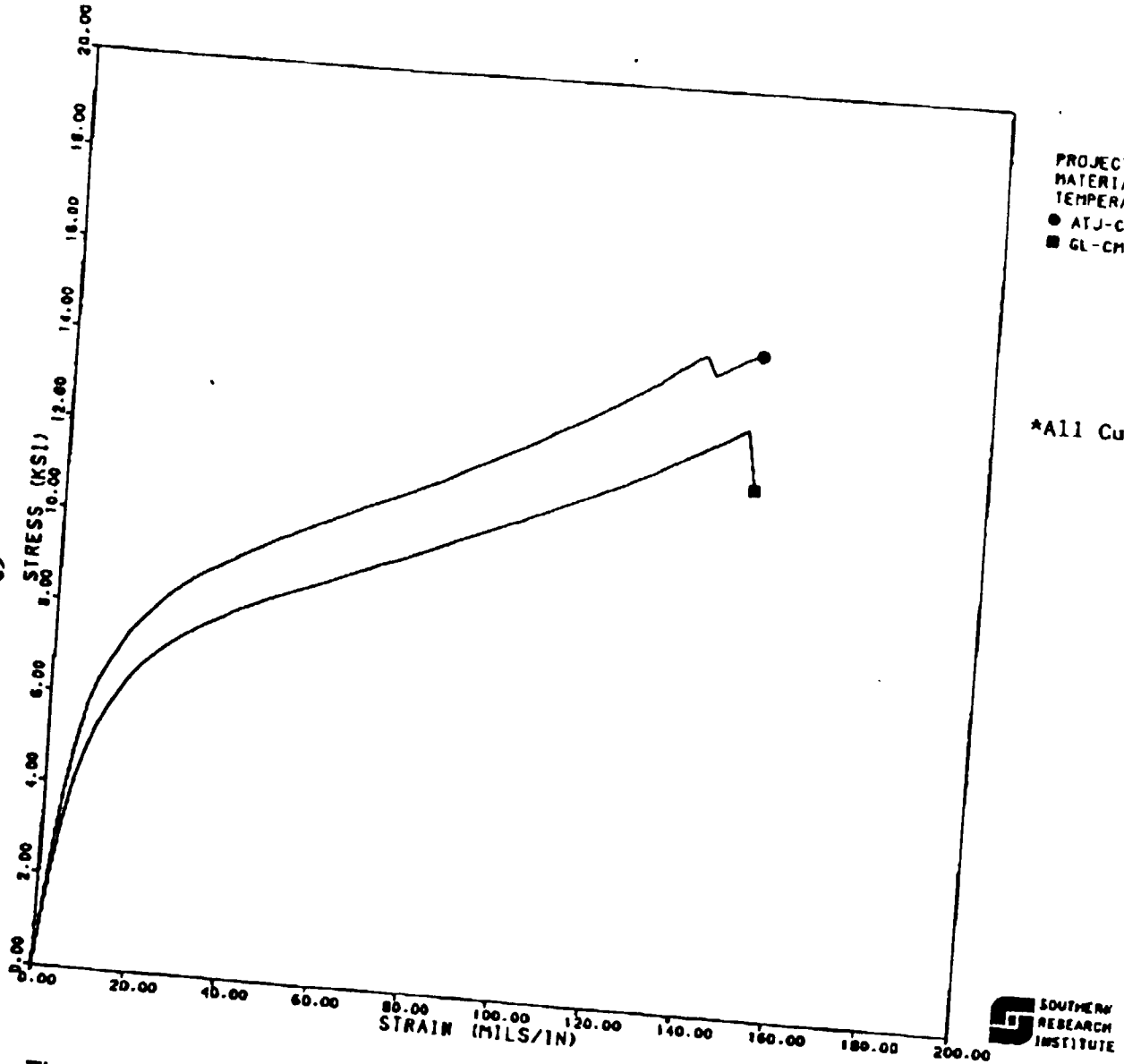


Figure 3.4-6. Compressive Across-Grain Comparison of Bulk Graphite Materials at 4250 °F

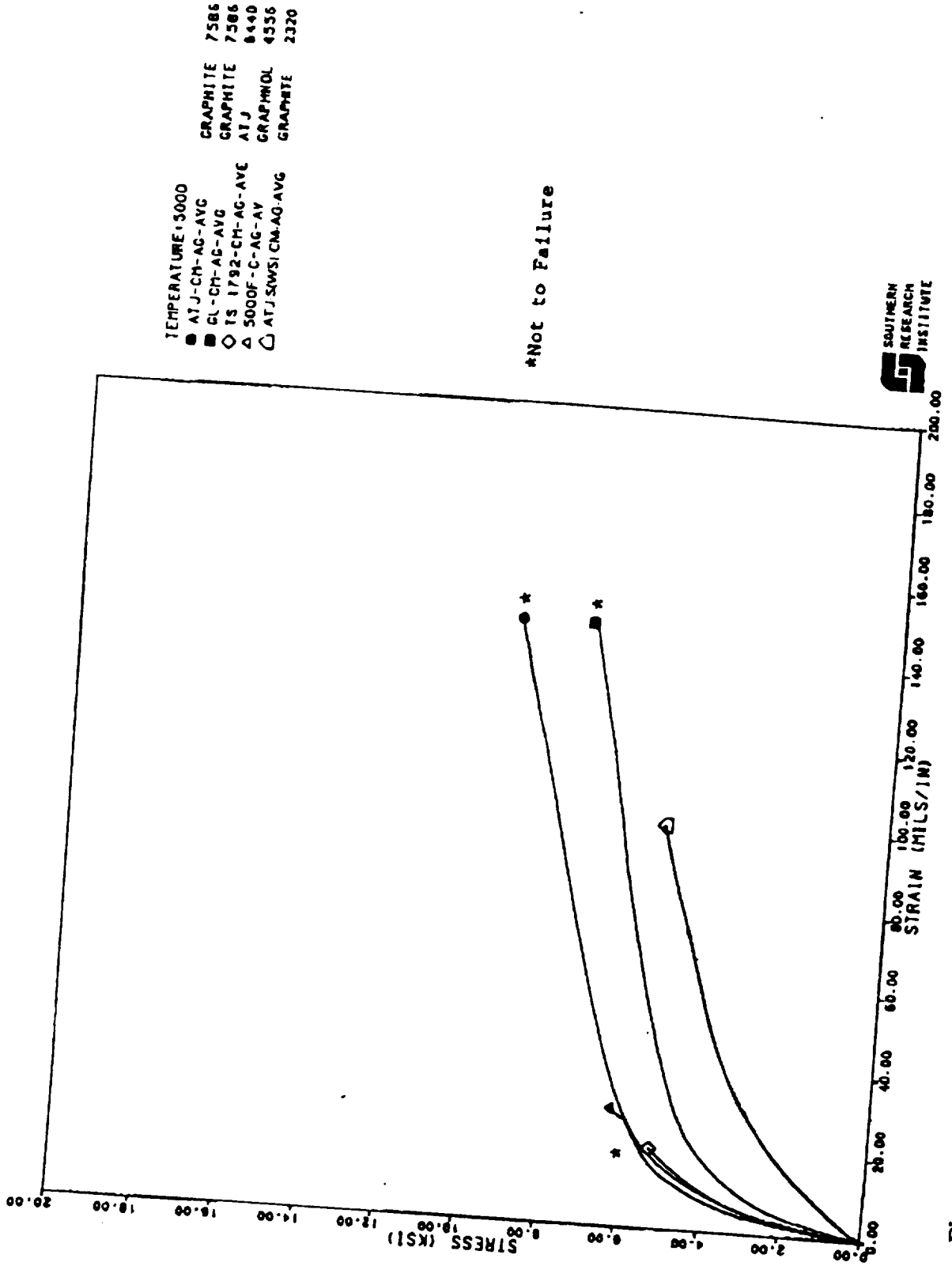


Figure 3.4-7. Compressive Across-Grain Comparison of Bulk Graphite Materials at 5000 °F

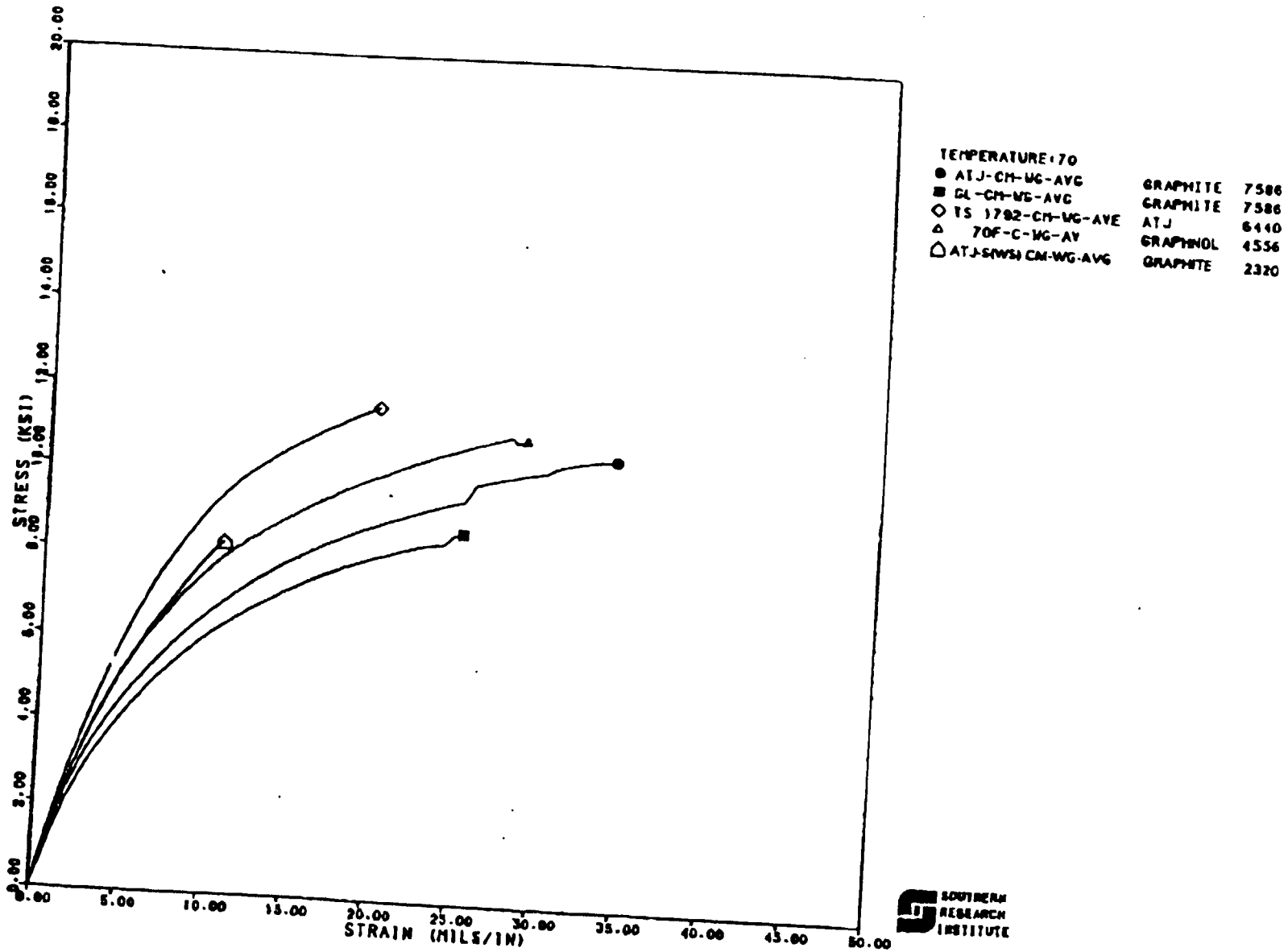


Figure 3.4-8. Compressive Across-Grain Comparison of Bulk Graphite Materials at Room Temperature

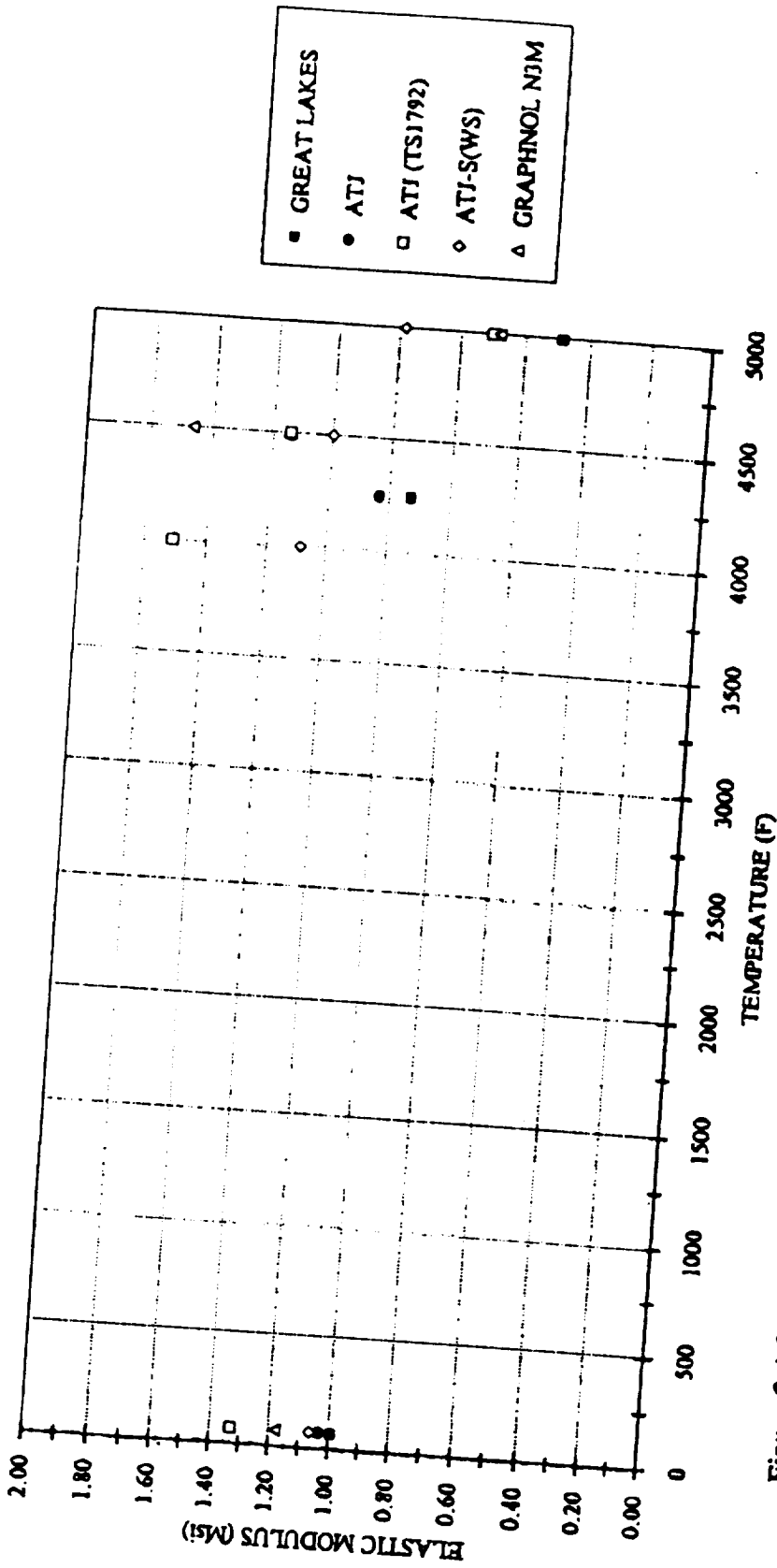


Figure 3.4-9. Compressive Across-Grain Elastic Modulus for Various Graphite and Graphnol Materials

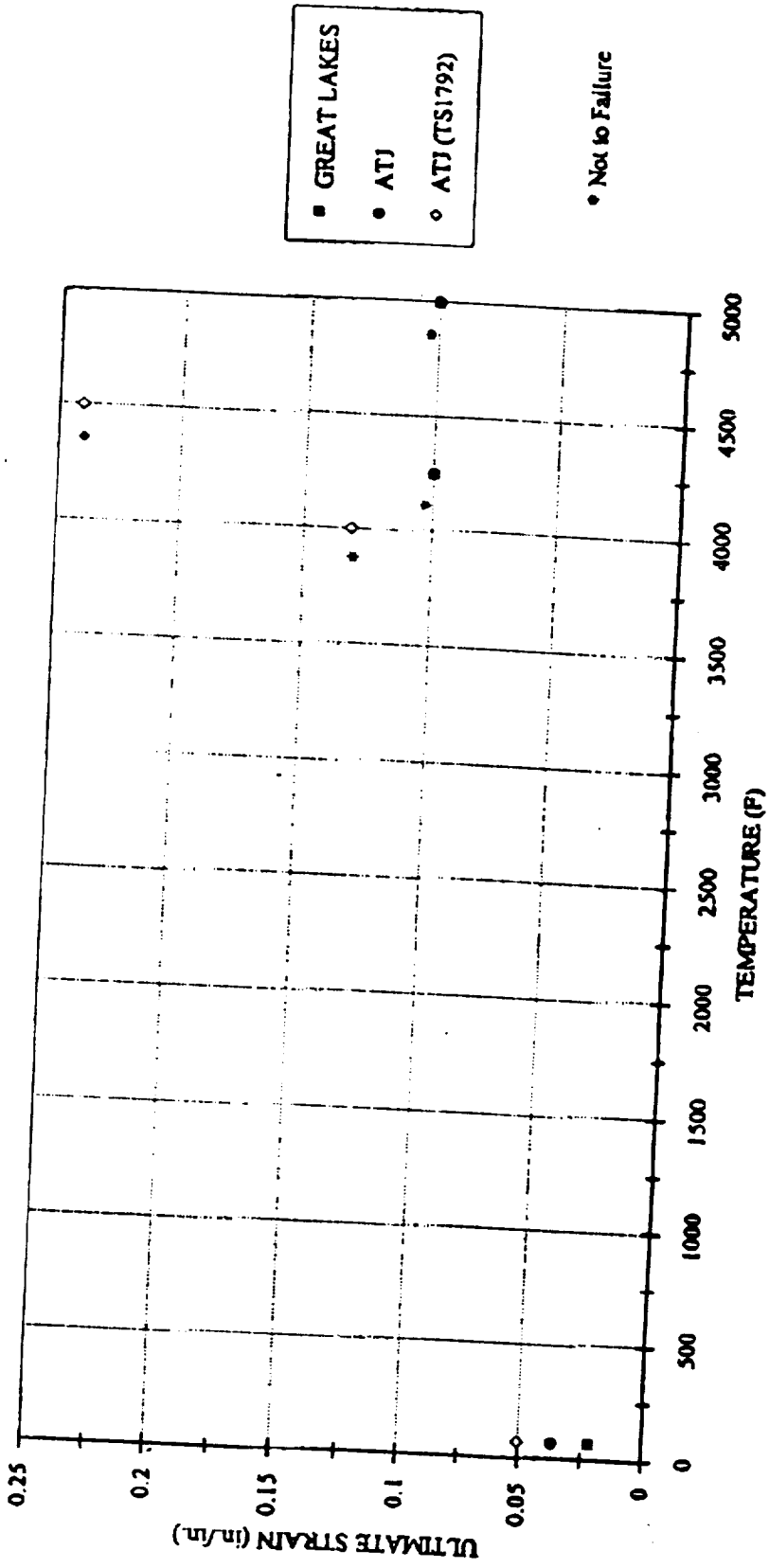


Figure 3.4-10. Compressive Across-Grain Ultimate Strain for Various Graphite and Graphnol Materials

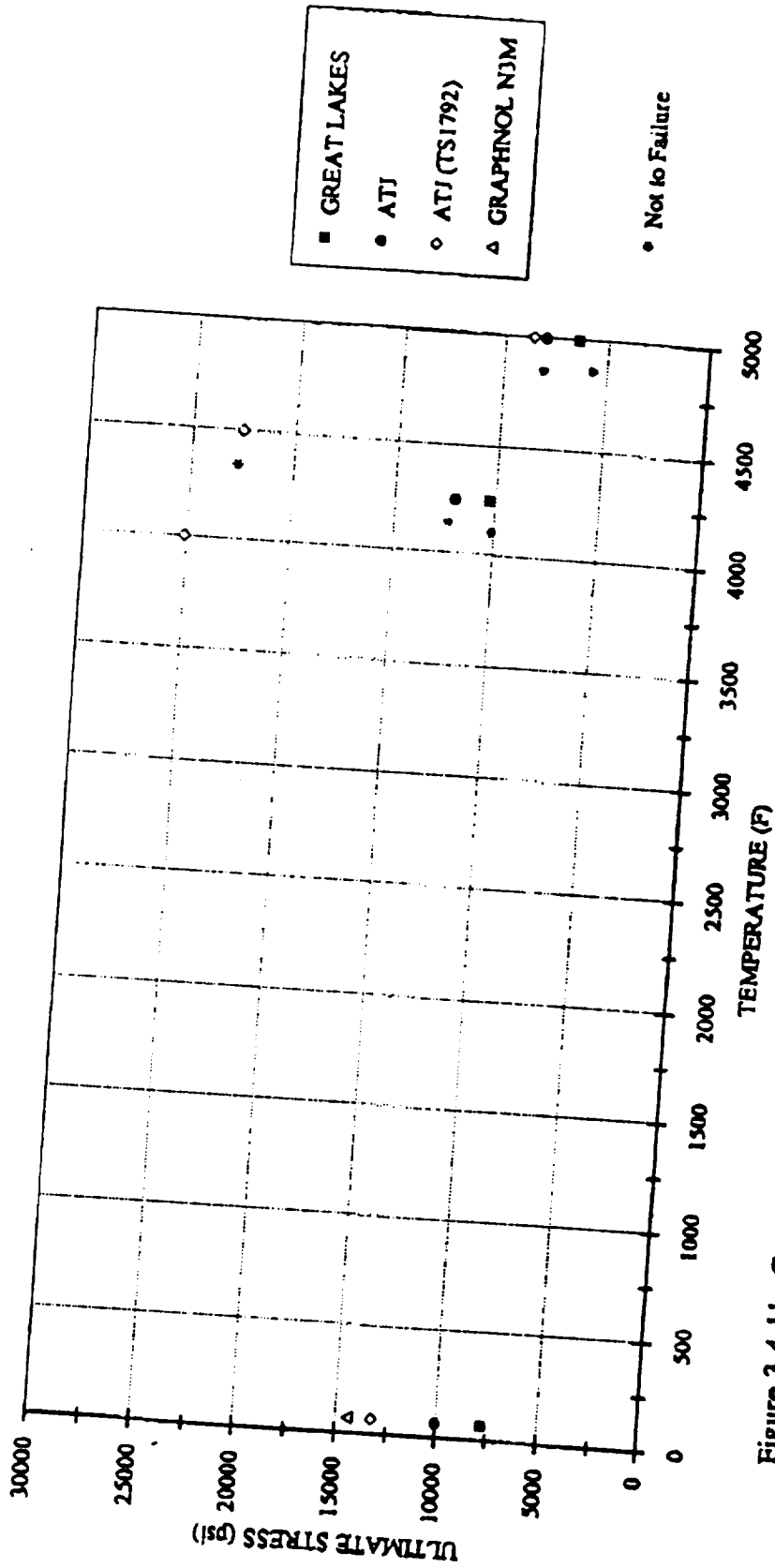


Figure 3.4-11. Compressive Across-Grain Ultimate Stress for Various Graphite and Graphnol Materials

Table 3.4-2. Summary ao Compressive Stress-Strain Data for the Average Curves of Graphite and Graphnol Materials

Material	Temp (°F)	Grain Direction	Stress Rate (psi/min)	Primary Elastic Modulus (Msi)	Stress At 0.2% Offset (psi)	Stress At 2% Strain (psi)	Stress at Ultimate (psi)	Strain at Ultimate (in/in)	Poisson's Ratio	Bilinear Fits to Average Stress-Strain Curves				
										Primary Modulus (E) (Msi)	Secondary Modulus (H) (Msi)	Yield Strain (S) (in./in.)	Yield Stress (Y) (psi)	Fit Extended to Percent Strain
GREAT LAKES ATJ	70	Across Grain	10000	0.99	1952	4330	7781	0.0219	-	-	-	-	-	-
ATJ (TS1792)	70	Across Grain	10000	1.03	2114.3	4625	10037	0.0368	-	-	-	-	-	-
ATJ-S(WS) .	70	Across Grain	-	1.33	-	-	13245	0.0504	-	-	-	-	-	-
GRAPHNOL N3M	70	Across Grain	10000	1.06	-	-	-	-	-	-	-	-	-	-
														-
ATJ (TS1792)	4000	Across Grain	10000	1.18	6170	9695	14410	-	0.132	1.064	0.453	0.0027	2915	-
ATJ-S(WS)	4000	Across Grain	10000	1.71	-	-	25108	> 0.1320	-	1.027	0.529	0.0033	3994	-
				1.28	-	-	-	-	-	-	-	-	-	1.0
GREAT LAKES ATJ	4250	Across Grain	10000	0.93	3300	5116	> 10332	> 0.1000	-	1 283	0 44	0.0037	4723	-
	4250	Across Grain	10000	1.03	3733	6297	> 12033	> 0.1000	-	-	-	-	-	-
ATJ (TS1792)	4500	Across Grain	-	1.34	-	-	>22575	> 0 2403	-	-	-	-	-	-
ATJ-S(WS)	4500	Across Grain	10000	1.20	-	-	-	-	-	-	-	-	-	-
GRAPHNOL N3M	4500	Across Grain	10000	1 67	6136	7840	-	-	-	-	-	-	-	-
GREAT LAKES ATJ	5000	Across Grain	10000	0.49	1766	3249	> 6431	> 0.1000	-	1.198	0.463	0.0032	3860	-
ATJ (TS1792)	5000	Across Grain	10000	0.68	2417	4133	> 8023	> 0.1000	-	1.632	0.330	0.0031	5118	-
ATJ-S(WS)	5000	Across Grain	-	0.70	-	-	8625	-	-	-	-	-	-	1.0
GRAPHNOL N3M	5000	Across Grain	10000	0.98	-	-	-	-	-	-	-	-	-	-
			10000	0.68	4068	5600	-	-	-	-	-	-	-	-
GREAT LAKES ATJ	70	With Grain	10000	1.14	2316	4832	8297	0.0233	-	0.981	0.363	0.0028	2765	-
ATJ (TS1792)	70	With Grain	10000	1.19	2550	5266	9807	0.0303	-	0.849	0.296	0.0029	2485	-
ATJ-S(WS)	70	With Grain	-	1.37	-	-	12935	0.0344	-	-	-	-	-	1.0
GRAPHNOL N3M	70	With Grain	10000	1.39	-	-	-	-	-	-	-	-	-	-
			10000	1.25	6445	10005	14175	-	0.147	1.386	0.0378	0.0028	3854	-
										1.208	0.516	0.0038	4622	-
														1.0

MATERIAL	PROJECT
ATJ (TS 1792)	6440
ATJ-S (WS)	2220
Graphnol N3M	3667-3

National Aeronautics and
Space Administration

George C. Marshall Space Flight Center
Marshall Space Flight Center, AL 35812

Reply to Attn of: SA41 (94-081)DR
Ricks/4-2690

APR 11 1994

USBI
Attn.: Mr. H. P. Blanks
P. O. Box 1900, West Station
Huntsville, Al 35807

Subject: Use of Isostatically Molded ATJ Graphite in the Booster Separation Motors (BSM)

The enclosed memo from MSFC's Materials and Processing Laboratory (EH01) documents their final assessment of the Isomolded ATJ Graphite for use in the BSM's. The memo states: "The isostatically molded ATJ graphite is acceptable for use in the BSM and the acceptance tests currently specified in the Source Control Drawing are sufficient to ensure a consistent material." This memo is to be included in the BSM Delta Qualification Test Report.

If you have any questions, please contact David Ricks at 544-2690.

Cary H. Rutland
Manager, Solid Rocket Booster Project Office

Enclosure

cc:
EA01/R. Schwinghamer
AP48/M. McClure
EP12/J. Niblett
EE11/J. Smith
EE13/ D. Russell/ D. Ricks
USBI-PM-HSV/C.Nelson/K.Hill/T. Hopper
USBI-ENG-HSV/W. Jackson/D. Wencil

National Aeronautics and
Space Administration

George C. Marshall Space Flight Center
Marshall Space Flight Center, AL 35812

Reply to Attn of: EH34(94-10)

FEB 3 1994

TO: EE11/James D. Smith

FROM: EH01/Paul H. Schuerer

SUBJECT: Final Assessment of Isomolded ATJ Graphite For Use In BSM Throats

Evaluation of the process change for the ATJ graphite used in the throat of the Solid Rocket Booster (SRB) Booster Separation Motors (BSMs) has been completed. It is the position of the Materials & Processes Laboratory that the material produced by the new process will perform acceptably. The evaluation included discussions with experts in the graphite material field, comparison of the material properties of the slurry molded ("old") versus the isostatically molded ("new") material, and an evaluation of the acceptance tests. The findings are discussed below.

When evaluating the material properties of the new versus the old material, the Castor IV and ATACMS data bases were evaluated for the new material, and the data provided by CSD/Union Carbide and a 1963 Air Force report were used for the old data. The old data consisted of the Union Carbide product data sheet, the results of a Union Carbide 1987 test series, and the 1963 Air Force report. The data from this Air Force report was used in the original nozzle analysis. Of the old data, the lowest properties were in the Air Force report, making the original analysis conservative. The highest properties were in the 1987 test series. The increase in property values would indicate improved test procedures and optimized processing with time.

The Castor IV data was used in the analysis for the new material since it was the most complete, and at the time the only data available. Materials and Processes Laboratory personnel knew of the ATACMS data from previous discussions with the Army and it was made available for this evaluation. The Castor material had the highest mechanical properties of all the data but it was discovered that the specific resistance was out of specification. The material properties from the ATACMS study were lower than those of the Castor, higher than both those of the Air Force study and the Union Carbide product sheet, and slightly lower than the Union Carbide 1987 test series data. Summarizing the data comparison, the isostatic process produces a material with properties within the same family as the slurry molded material. The performance of the material should not be affected.

Since the specific resistance for the Castor data was out of specification, CSD conducted an analysis using the ATACMS data and compared the results given by both. This review showed that while the results were not as good for the ATACMS as for the Castor properties, both produced higher margins than the original analysis. The high specific resistance of the Castor material was attributed to a lower graphitization temperature. Based on our discussions with those who have an extensive background with characterization of graphite materials, it is expected that the higher specific resistance material would also have higher mechanical properties, which is consistent with the data. The Castor IV material was produced in 1987, the first year of production of the isostatic molded material. It took Union Carbide several years to fine tune the process to consistently produce a material that had the same basic properties as the old material. This may explain why the Castor material was out of specification with consequent higher mechanical properties, and also why the ATACMS data, material manufactured in 1991-92, is more representative of that which will be flown in the BSM's.

The adequacy of the acceptance tests was questioned and a correlation of the acceptance data with the analytical data was requested. The acceptance tests performed are the following: density, specific resistance, flexural strength, ultrasonic inspection, alcohol wipe, and visual inspection. After lengthy discussions with industry experts it is believed that, while additional tests or modifications to current tests may improve our knowledge, the current acceptance tests are adequate. The density relates to the number of densification cycles the material has seen. The specific resistance relates to the maximum graphitization temperature. Flexural strength is a mixed mode failure and not useful for analytical purposes, but when compared to the large data base of results it provides an indicator of the "goodness" of the material strengths. Ultrasonic inspection will reveal internal defects, greater than 1/8" in diameter. The visual inspection and alcohol wipe will find surface cracks or defects. The purpose of acceptance tests is not to characterize the material but to demonstrate that each batch of material is like the other batches produced and tested. The processing is what makes the material graphite. These acceptance tests evaluate properties which relate the material with the process and thereby provide a good indication of the consistency of the material from batch to batch.

A correlation was attempted between the acceptance data and the analytical data but there was not the consistency from test program to test program to complete it. For example, the Castor data set had specific resistance properties for the thermal expansion specimens while the ATACMS data set had specific resistance properties for the compressive test specimens. No individual test data was found for the old material. Density was evaluated, but all the data was in a small enough band that no correlation could be determined. A test matrix could be recommended and the correlation developed. However, it is the position of the Materials and Processes Laboratory that such a correlation is not necessary and program funds could be more effectively used elsewhere.

The final and most significant element comprising our position that the isostatically molded ATJ is acceptable is derived from a combination of our understanding of the graphite material, thorough evaluation of the above information, and comparing these to the environment this material will experience in the BSM. The BSM burns for 0.9 seconds and the graphite reaches a maximum surface temperature of 3000°F. Graphite is processed at temperatures in excess of 4500°F and the material expansion does not begin to cause significant internal loading until the material reaches 3500°F. Thermal stress is typically a major issue with graphite, but in this application the ATJ has insufficient time to develop enough thermal stress to create concern. Due to these factors the ATJ graphite's capabilities, whether the isostatically molded or the slurry molded, are never seriously challenged.

The purposes of this memorandum have been to document the findings of this review and to clearly state the reasons for the Materials and Processes Laboratory position. The isostatically molded ATJ graphite is acceptable for use in the BSM and the acceptance tests currently specified in the Source Control Drawing are sufficient to ensure a consistent material. Should there be any further questions please contact Tim Lawrence, 4-2660.

Paul H. Schuerer

Paul H. Schuerer
Director
Materials & Processing Laboratory

cc
EE13/D. Ricks
EH31/C. McIntosh
EH34/R. Clinton/T. Lawrence

WAIVERS/DEVIATIONS - AFT MOTORS - Lot AAY

NOMENCLATURE	PART NUMBER	SERIAL NO	NCR	VMRR	DAR
Motor Assy, Final	B12000-14-01	1000734	D12181		
Motor Case, Loaded	B12002-02-01	I0705	D10909		
Case/Aft Closure	B12018-02-01	I0705	B13616 (superseded by B19943)		
Case/Aft Closure	B12018-02-01	I0705	B19943		
Adapter, Igniter	B12016-02-02	5568	D05044		
Nozzle Assembly	B12003-10-01	I0705	D11910		
Nozzle Assembly	B12003-10-01	I0705	D11923	006184	
Nozzle Assembly	B12003-10-01	I0705	D12186		
Closure, Aft	B12018-14-01	I0705	D10070		
Anti-Oxidant	SE0724	Lot 20 All Motors	D08388		
HX-752	SE0754	Lot 50 All Motors	D08262		
Nozzle Assembly	B12003-10-01	I0705	D14417		

DATA ACCEPTANCE RECORD

TITLE: LOADED MOTOR - BSM	REL. #: MRC 256476-02	PAGE 11 OF 17
	PART #: B12002-02-01	DAR REV.: B

ITEM CAT ZONE METHODS CODE SOURCE	DATA MANAGEMENT			FINAL ACCEPTANCE		
	DESIGN LIMITS		DATA RECORDING	OPERATOR	QUALITY	CUST/GOV
INSPECTION INSTRUCTIONS	MIN.	MAX.		STP-DT	STP-DT	STP-DT

D014 CONT.
(PCS 044618)

D014	D014(A)	D014(B) MANDREL REMOVAL (SE0727, Para. 3.9.1) (2100 psig HANNIFIN MODEL 88-H11C) (725 psig SHEFFER CYLINDER 3 1/4 MH-RHF-5-CC)		D014(C) MOTOR/PROPELLANT CAST WEIGHT 75.3 - 78.3 LBS. (Dwg. Note 2)			
CASE S/N	MOTOR I.D. (Dwg. Note 1) OPS	REMOVAL FORCE	OPS	CASE + PROPELLANT LBS.	LINED CASE LBS. (SEE D001(F)	NET WEIGHT PROPELLANT	
I694 ~~I0694~~	3-30-93	PSI 550 LBF 3750	2-25-93	122.4	45.7	76.7	MAR 3 0 1993 MAR 3 0 199
I0705	3-30-93	PSI 600 LBF 4200	2-25-93	122.9	45.6	77.3	MAR 3 0 1993 MAR 3 0 199
I0708	3-30-93	PSI 600 LBF 4200	2-25-93	122.4	45.7	76.7	MAR 3 0 1993 MAR 3 0
I0719	3-30-93	PSI 550 LBF 3750	2-25-93	122.7	45.6	77.1	MAR 3 0 1993 MAR 3 0

588

FEB 8 '93

CONFIGURATION, AS BUILT AFT BOOSTER SEPARATION MOTOR
USBI P/N N/A
APPLICABLE TO LOT AAY

COMPONENT	PART NO.	REV	ECO'S	SERIAL NUMBERS
ROCKET MOTOR ASSEMBLY	B12000-14-01	*1		1000 734
LOADED CASE CASE AND AFT CLOSURE ROCKET MOTOR CASE	B12002-02-01 B12018-02-01 B12001-02-01	N E E	29665, 31077 31597	I0705
IGNITER ASSEMBLY IGNITER ADAPTER	B12011-06-01 B12016-02-02	*1 B		5568
TRANSDUCER PORT PLUG	B13348-01-01	A		N/A
$BKNO_3$ GRANULES, BAGGED	B12017-03-01	D		N/A
TBI PORT PLUG, RED	BC-20003-01	-		N/A
IGNITER CASE	B12014-01-02	B	26527, 27492	5551
RETAINER BOOSTER CHARGE	B12015-03-01	B	27662	5576
CENTERING INSERT	B12400-01-01	A	27379	N/A
IGNITER GRAIN GRAIN SUPPORT ROD	B12350-02-01 B12349-02-01	B A	27378, 28984	5513
NOZZLE ASSEMBLY AFT CLOSURE/NOZZLE SHELL FORGING (CLOSURE)	B12003-10-01 B12006-02-01 B12007-01-01	*1 D D		I0705
CLOSURE INSULATION	B20748-01-01	A		N/A
THROAT INSERT	B12004-02-01	B		0001
EXIT CONE	B12005-04-01	G		6599
WEATHER SEAL	B12099-01-01	B		N/A

Aft Motor 1000734

NCR: D12181 PLANT: COY DISC CAT: MT REF NO: PR/MRB: MRB WC/OB: REPORT DATE: 09/08/93 PAGE: 1

DISC P/N: B12000-14-01
DISC P/NAME: BSM MOTOR ASSY - Q2
MFG PART NO:
MFG PART NM:
MFG SER NO:
PLAN REL: MFGA96738
PROJECT NO: 5597
BUILDING: 0485
WORK AREA: PBS

UOM: EA
LOT SIZE: 1
REJECT NO: 1
CAR/FRR:

NCR DATE: 09/02/93
DISPOSITION DATE: 09/02/93
CLOSE DATE: 09/07/93
DPRO COMMENTS: NO

PO:
VENDOR NO: 000000
VEND NAME:
VEND DOC NO:

INSPECTOR	N/A	
VALIDATION	MIKE KISKILA	09/02/93
DISPOSITION	LARRY MURPHY	09/02/93
CAUSE/CA (UTC)	N/A	09/02/93
CAUSE/CA (VEN)	CAROL DANIELS	
QUAL DES ENGR	CAROL DANIELS	09/03/93
CUSTOMER	PAUL LUNDY	09/03/93
CUSTOMER		09/03/93
GOVT REP	RAYMOND CORREA	
MFG ENG REWORK	N/A	09/03/93
PURCH BUYER	N/A	09/03/93
INSP ACCEPT	ROBERT LOPEZ	09/03/93
		09/07/93

NCR NARRATIVE

MOTOR 1000734. DISCREPANCY FOUND ON REVIEW OF BUILD PAPER.

ITEM INFORMATION

ITEM:	OPER NO:	AFF QTY:	SERIAL NO:	DWG SPEC:	DEFECT CODE:	RESP ORGN:	OCC/REC:	DISP CODE:	DISP QTY
01	PD010A	1	1000734	SE2017PARA3.3.13.3	335 26	QACA	001	A	1

DISCREPANCY & DISPOSITION

ITEM: 01

DISCREPANCY DESCRIPTION:
SPEC REQUIRES OVEN CURE 24 HOURS @ 100+/-10 DEG.
IS: MOTOR CURED 48 HOURS @ AMBIENT (72 TO 74 DEG).
NOTE:WITNESS PANEL SOAK @ 49 HRS TO 73 HRS. PASSED PEEL TEST
ADHESIVE BONDING DONE @ 75 HRS AFTER START OF AMBIENT CURE.

DISPOSITION DESCRIPTION:
USE-AS-IS. RISPW UNAFFECTED. CURE AT TEMPERATURE IS A MANU
FACTURING AID TO REDUCE PROCESSING TIME. THE PAINT IS AN
EPOXY PAINT THAT WILL CURE AT ROOM TEMPERATURE, IT JUST TAKE
S LONGER. THE ADEQUACY OF THE CURE IS DEMONSTRATED BY THE
FACT THAT THE WET TAPE TEST AND THE CORK PORTAPULL (CONT.)
TESTS WERE SUCCESSFUL ON THE CORK PANELS AND WITNESS PANEL.
THE FUNCTIONALITY OF THE PAINTED CORK PANELS WILL BE UNAF-
FECTED BY THE AMBIENT CURE INSTEAD OF AN ACCELERATED CURE AT
ELEVATED TEMPERATURE.

CAUSE & CORRECTIVE ACTION

ITEM:	CAUSE CODE:	CAUSE NARRATIVE:	CA CODE:	CORRECTIVE ACTION NARRATIVE:
01	12	WHEN PLANNING WAS WRITTEN, THE REQUIREMENT OF SE2017 PARAGRAPH 3.3.16.3 WAS INCORPORATED WHICH IS FOR CURING OF CORK PAINT WHICH ALLOWS AMBIENT CURE, RATHER THAN PARAGRAPH 3.3.13.3 WHICH IS FOR CASE PAINT CURE. NEITHER THE AUTHOR NOR PLANNING REVIEWERS CAUGHT THE ERROR.	12	PCS IS BEING WRITTEN TO DELETE AMBIENT CURE ALLOWANCE IN THE PLANNING. THE AUTHOR OF THE PLANNING AND ALL REVIEWERS ARE AWARE OF THE MISTAKE AND THE NEED TO BE MORE CAREFUL.

NCR: D10909 PLANT: COY DISC CAT: MT REF NO: N/A PR/MRB: MRB WC/OB: REPORT DATE: 09/02/93 Page 1

DISC P/N: B12002-02-01
DISC P/NAME: BSM LOADED MOTOR
MFG PART NO: N/A
MFG PART NM: N/A
MFG SER NO: N/A
PLAN REL: MULT
PROJECT NO: 5597
BUILDING: 0700
WORK AREA: PBS

UOM: EA
LOT SIZE: 64
REJECT NO: 36
CAR/FRR:

NCR DATE: 03/09/93
DISPOSITION DATE: 08/18/93
CLOSE DATE: 08/19/93
DPRO COMMENTS: YES

PO:
VENDOR NO: 000000
VEND NAME:
VEND DOC NO: N/A

INSPECTOR	MARK RADOVIC	
VALIDATION	MIKE KISKILA	04/30/93
DISPOSITION	LARRY MURPHY	04/14/93
CAUSE/CA (UTC)	RICHARD DOUGLAS	08/18/93
CAUSE/CA (VEN)	N/A	08/09/93
QUAL DES ENGR	MIKE KISKILA	08/18/93
CUSTOMER	DWAYNE W. WILSON	08/18/93
CUSTOMER		
GOVT REP	RAYMOND CORREA	08/19/93
MFG ENG REWORK	N/A	08/19/93
PURCH BUYER	N/A	08/19/93
INSP ACCEPT	MARK RADOVIC	08/19/93

NCR NARRATIVE

MRC256472,S/NI582,I596,I586,I534,I549,I536
SEE INTERIM DISPOSITION #1 - CONTINUE PROCESSING INTO PHASE III OP 20 AND THROUGH LAT. MK 3/12/93 CONT.... MRC256471 S/N I546, I547. MRC256470 S/N I568,MRC256469 S/N I609, S/N I0770, S/N I599,S/N I691, MRC256474 S/N I0619, S/N I598, S/N I588,MRC256476 S/N I0512, S/N I0705 S/N I0719, S/N I0682, S/N I0511, S/N I694, MRC256475 S/N I0575,I0721, I0684,I0557,I0573,I0567,I0572,MRC 256473 S/N I0667,I593,I585,I0648,I0616, I0620,I0624.MKR 04/30/93

ITEM INFORMATION

ITEM:	OPER NO:	AFF QTY:	SERIAL NO:	DWG SPEC:	DEFECT CODE:	RESP ORGN:	OCC/REC:	DISP CODE:	DISP QTY
01	D016	36	MULT.	NOTE 8	355 26	21200	N	A	36

DISCREPANCY & DISPOSITION

ITEM: DISCREPANCY DESCRIPTION:
01 S/B:NONE ALLOWED IS:VISUAL INSPECTION REVEALS NON HOMOGENOUS PROPELLANT.

DISPOSITION DESCRIPTION:
USE-AS-IS. RISPW UNAFFECTED. SMALL AREAS OF NON-HOMOGENEOUS PROPELLANT ARE INHERENT IN THE MIXING AND CASTING PROCESS. USE OF PROPELLANT WITH THESE AREAS WHICH ARE SMALLER THAN THE 3/8 INCH VOID CRITERIA IS ACCEPTABLE AS EVIDENCED BY THE ACCEPTABLE PERFORMANCE OF LOTS AAU, AAW, AAX AND AAY. (-->) LOT VMRR'S ARE AAU-006164, AAW-006173, AAX-006180. THE 3/8 INCH REQUIREMENT COMES FROM SE 0727 PROP. PROC. SPEC. THE BALLISTIC PERFORMANCE OF ALL OF THESE LOTS HAS BEEN NORMAL AND WITHIN FAMILY AT THE 30 DEGREE AND 120 DEGREE FIRING TEMPERATURES. LOTS AAU, AAW AND LOT AAX WERE ALSO EVALUATED BY HIGH SPEED FILM TO DETERMINE IF ANY GENERATED DEBRIS WAS OBSERVABLE. THERE WAS NONE. THE SPOTS NOTED ON THE AFT MACHINED PROPELLANT SURFACE OF LOT AAY MOTORS WERE SO SMALL, (<0.010 INCH DIAMETER), THAT CLOSE VISUAL INSPECTION WAS REQUIRED TO MAP THEM. THE QUANTITY ON EACH MOTOR WAS ALSO VERY LOW (SEVERAL). SMALL AREAS OF PROPELLANT OF THIS TYPE WILL NOT AFFECT MOTOR PERFORMANCE.

CAUSE & CORRECTIVE ACTION

TEM: CAUSE

CAUSE NARRATIVE:

CA

CORRECTIVE ACTION NARRATIVE:

	CODE:	
01	40	SEE CAR CAXX131.

CODE:
40 PCS 44596 WAS APPROVED ON 3/25/93 AND IS IN THE SYSTEM. THIS PCS LOWERS THE THRESHOLD FOR HOLDING DURING THE AP ADD FROM 10-TO-12 KW TO 8-TO-10 KW. WE HAVE NOT YET MADE A PROPELLANT BATCH WITH THIS PCS IN PLACE.

HH 1-21

COMPLETED

B17743

UNITED TECHNOLOGIES CHEMICAL SYSTEMS — Non-Conformance Report

1 CSD / VENDOR ✓ | 2 DISCREPANCY CATEGORY: ☐ Mfg/Test ☐ Design Dev ☐ Suspect Failure ☒ RI / Supplier ☐ GFP ☐ Tooling (AGE) ☐ Launch Site | 3 REFERENCE NO N/A Mfg 11/1/88 | 4 NCR NO B 13616 | 5 PAGE 1

6 MFG END ITEM NAME	7 MFG END ITEM P/N	8 MFG END ITEM S/N	9 JOB / PLAN / PROC	10 PROJECT	11 LOCATION
N/A	N/A	N/A	B17305	5332	SAN JOSE

12 DISCREPANT ITEM NAME	13 DISCREPANT ITEM P/N	14 VENDOR NAME / CODE	15 RECEIVER / P O NO & LINE ITEM	16 UNIT OF MEAS	LOT SIZE	NO
CASE MATCHED SET CLOSURE	B12018-02-01	THIEM-IND/04125	210397-2:00	EA	64	64

17 ITEM	18 OP NO	19 QTY AFFECTED	20 SERIAL NUMBER	DISCREPANCY / APPLICABLE SPECIFICATIONS: 21 DRWG ZONE SPEC PARA	22 DIMENSION SPEC NOMINAL	23 TOLERANCE LIMITS	24 DESCRIPTION	25 DEFECT CODE	26 RESP ORGN	27 RECURR
1	N/A	64	9/20/88 SEE CONTINUATION SHT mcs 9/20/88	(2) 4 H STD500 method 11 B	(2) 9/20/88 Design Code, P/N, S/N, rev letter + Mfg Code	NONE	~~ITEM 1 MARKING~~ mcs 9/20/88 REV. LETTER (E) OMITTED ~~FROM MRB~~ mcs 9/20/88 ~~MARK~~ ~~TRADE NAME OR NAME ON ITEMS 4 & 5~~ mcs 9/20/88 Mfg code identification missing from item 4 (B12018-13-01, Case Subassembly) SEE CONTINUATION SHT mcs 9/20/88	01014	VEND	N/A

28 ORIGINATOR	DATE	29 QUALITY ENGINEER	DATE	30 OPERATIONS	DATE	31 CUSTOMER	DATE
M Nock	9/7/88	M C Schmacher	9/21/88	N/A mcs		N/A mcs	

32 SUPPLIER ONLY INFO: DWG REV E; ITOs 29665

32 NARRATIVE:

~~*CSD is the design activity/agency~~ mcs 9/20/88, 3 Set/serial NOs - 619, 622, 543, 6068, 661, 578, 682, 709, 6036, 724, 620, 608, 704, 518, 630, 527, 595, 321, 572, 690, 683, 576, 573, 674, 560, 559, 719, 524, 557, 576, 684, 721, 660, 623, 687, 510, 577, 634, 6162, 617, 514, 618, 556, 705, 637, 708, 608, 722, 721, 580, 535 + 567. (ALL S/N RECEIVED BY PREFIX "I") mcs 9/23/88

*(2) identification applies to item 4 only M C Schmacher 9/23/88

THIS NCR SUPERSEDED BY NCR B19145 TO ACCOMODATE NMO REJECTION

34 C/A / CAR / FRR: ☐ No C/A req'd ☐ CAR ☐ FRR ☒ C/A (Refer to the last page of this form)

35 ITEM	36 QTY	37 DISP CODE	38 ITEM DISPOSITION	39 OPERATIONS	40 QUALITY
				11-8-88	

41 DISPOSITION AUTHORITY M C Schmacher 11/1/88: ☐ PR ☒ MRB ☐ Major

42 THIS DISPOSITION DOES NOT ADVERSELY AFFECT: ☐ Safety ☐ Weight ☐ Performance ☐ Reliability ☐ Interchangeability

DISPOSITION APPROVALS

	DATE
43 ENGINEERING	
44 OPERATIONS	
45 QUALITY ASSURANCE	
46 OTHER	
47 CUSTOMER	
48 AFQA POST REVIEW	

IF A WAIVER IS GRANTED THE FOLLOWING STATEMENT APPLIES: This approval does not constitute a waiver on the part of the government for any claim for equitable price adjustment as the contracting officer may deem appropriate because of such waiver or deviation. This disposition does not establish a precedent for future dispositions.

594

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

NCR Discrepancy Continuation Sheet

12 DISCREPANT ITEM NAME: CASE MATCHED SET CLOSURE | 13 DISCREPANT ITEM P/N: B12018-02-01 | 28 ORIGINATOR: M DALY | DATE: 9/7/88 | 4 REF NCR NO: B13616 | 5 PAGE: 2

17 ITEM	18 OP NO	19 QTY AFFECTED	20 SERIAL NO	21 DISCREPANCY/APPLICABLE SPECIFICATIONS DRWG ZONE SPEC PARA	22 DIMENSION SPEC NOMINAL	23 TOLERANCE LIMITS	24 DESCRIPTION	25 DEFECT CODE	26 RESP ORGN	27 RECURR
2	N/A	2	SEE CONT. SHT 502 + 557	12 G SHT 10	16	NONE	ITEM 2 CONVERSION LOAT OMITTED CLOSURE SET # 562 DIA 11.566-11.564 (SEE pg 7 and DWG B12006-02-01, ZONE 8-E-C)	13514	VEND	N/A
N/A				12 G SHT 2	16	NONE	CASE SET # 557 FORWARD END ON 3.530 DIA, APPROX 1" DIA SPOT (See dwg B12018, ZONE 7/C)			
3	N/A	3	657, 690 + 708	G 8 B12001-02-01 3	A	NONE	ITEM 3 NICKS ON PRIMERY ORING SEAL FROM DOWEL PIN CLOCK WISE (Aft looking fwd) at 120° (S/N 657), 35° (S/N 708) + 30° (S/N 690). See pg 9. SET # 657 APPROX 120° SET # 708 35° SET # 690 30° WORST CONDITION NICK .005 DEEP	25034	VEND	N/A
4	N/A	3	704, 526 + 595	6 E B12006-02-01	3	NONE	ITEM 4 NICKS ON THRDS (Case to closure threads, see pg 7.) CLOSURE SET # 595 704 526	24534	VEND	N/A
5	N/A	1	520	8 G B12001-02-01 Visual	125	MAX NONE	ITEM 5 SCRATCHES SET # 520 ON 11.954 DIA ALL AROUND .005 DP (See pg 9)	25070	VEND	N/A

595

3 REFERENCE NO

UNITED TECHNOLOGIES

NCR Discrepancy Continuation Sheet

12 DISCREPANT ITE: MATCHED SET CASE Closure

13 DISCREPANT ITEM P/N: B12018-02-01

28 ORIGINATOR: M DULY

DATE: 9/7/88

4 REF /NCR NO: B13616

5 PAGE: 3

17 ITEM	18 OP NO	19 QTY AFFECTED	20 SERIAL NO	21 DISCREPANCY / APPLICABLE SPECIFICATION DRWG /DOC SPEC PARA	22 DIMENSION SPEC NOMINAL	23 TOLERANCE LIMITS	24 SET #	DESCRIPTION 1	2	3	4	5	25 REJECT CODE	26 RESP ORGN	27 RECURR
							619	X							
							622	X							
							543	X							
							668	X							
							661	X							
							578	X							
							682	X							
							709	X							
							636	X							
							724	X							
							620	X							
							658	X							
							704	X							
							518	X							
							630	X							
							540	X							
							689	X							
							511	X							
							624	X							

~~9/7/88~~ 9/7/88

9/20/88

3 REFERENCE NO

D 11188 (87/11)

596

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

NCR Discrepancy
Continuation Sheet

9

12 DISCREPANT ITEM NAME	13 DISCREPANT ITEM P/N	28 ORIGINATOR	DATE	4 REF NCR NO	5 PAGE	OF
CASE MATCHED SET CLOSURE	B12018-02-01	M. DALY	9/7/88	B13616	4	4

17 ITEM	18 OP NO	19 QTY AFFECTED	20 SERIAL NO	DISCREPANCY/APPLICABLE SPECIFICATIONS 21 DRWG ZONE SPEC PARA	22 DIMENSION SPEC NOMINAL	23 TOLERANCE LIMITS	24 SET #	DESCRIPTION 1	2	3	4	5	25 DEFECT CODE	26 RESP ORGN	27 RECURR
							512	X							
							522	X							
							657	X		X					
							520	X				X			
							562	X	X						
							579	X							
							526	X		9/7/88 X	X				

MES 12/6/88

3 REFERENCE NO

597

UNITED TECHN

NCR Discrepancy Continuation Sheet

12 DISCREPANT ITE: CASE MATCHED SET Closure | 13 DISCREPANT ITEM P/N: B12018-02-01 | 28 ORIGINATOR: M. DAly | DATE: 9/7/88 | 4 REF /NCR NO: B13616 | 5 PAGE: 5 OF 6

17 ITEM	18 OP NO	19 QTY AFFECTED	20 SERIAL NO	21 DISCREPANCY/APPLICABLE SPECIFICATIONS DRWG ZONE SPEC PARA	22 DIMENSION SPEC NOMINAL	23 TOLERANCE LIMITS	24 SET #	DESCRIPTION 1	2	3	4	5	25 DEFECT CODE	26 RESP ORGN	27 RECURR
							656	X							
							527	X							
							595	X		9/7/88	X				
							521	X							
							572	X							
							690	X		X					
							683	X							
							575	X							
							573	X							
							674	X							
							560	X							
							559	X							
							719	X							
							524	X							
							557	X	X						
							576	X							
							684	X							
							726	X							
							660	X							

WCS 9/20/88

UNITED TECHNO

NCR Discrepancy Continuation Sheet

12 DISCREPANT ITE: MATCHED SET CASE Closure

13 DISCREPANT ITEM P/N: B12018-02-01

28 ORIGINATOR: M DALY

DATE: 9/7/88

REF /NCR NO: 13 13616

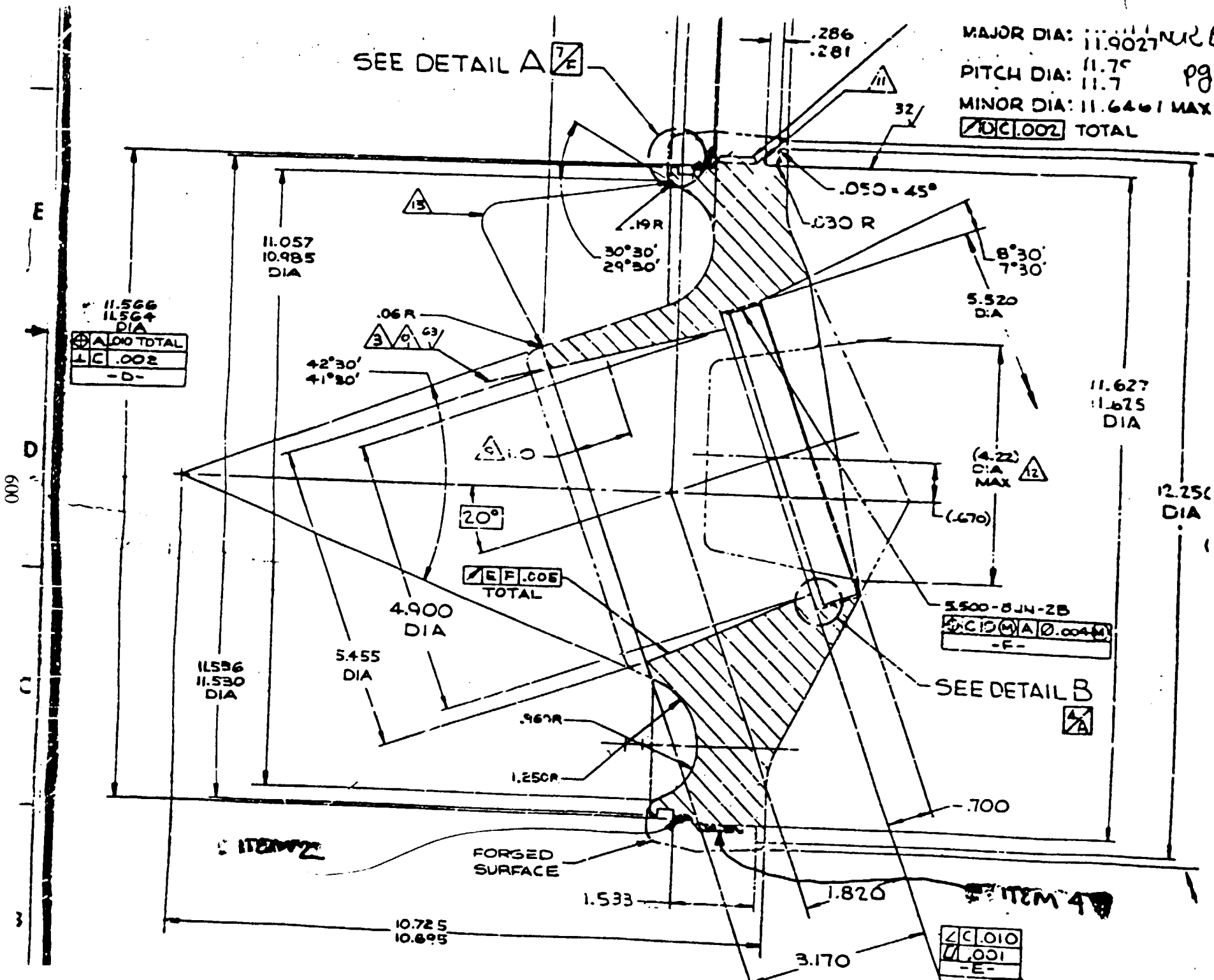
5 PAGE: 6 OF 9

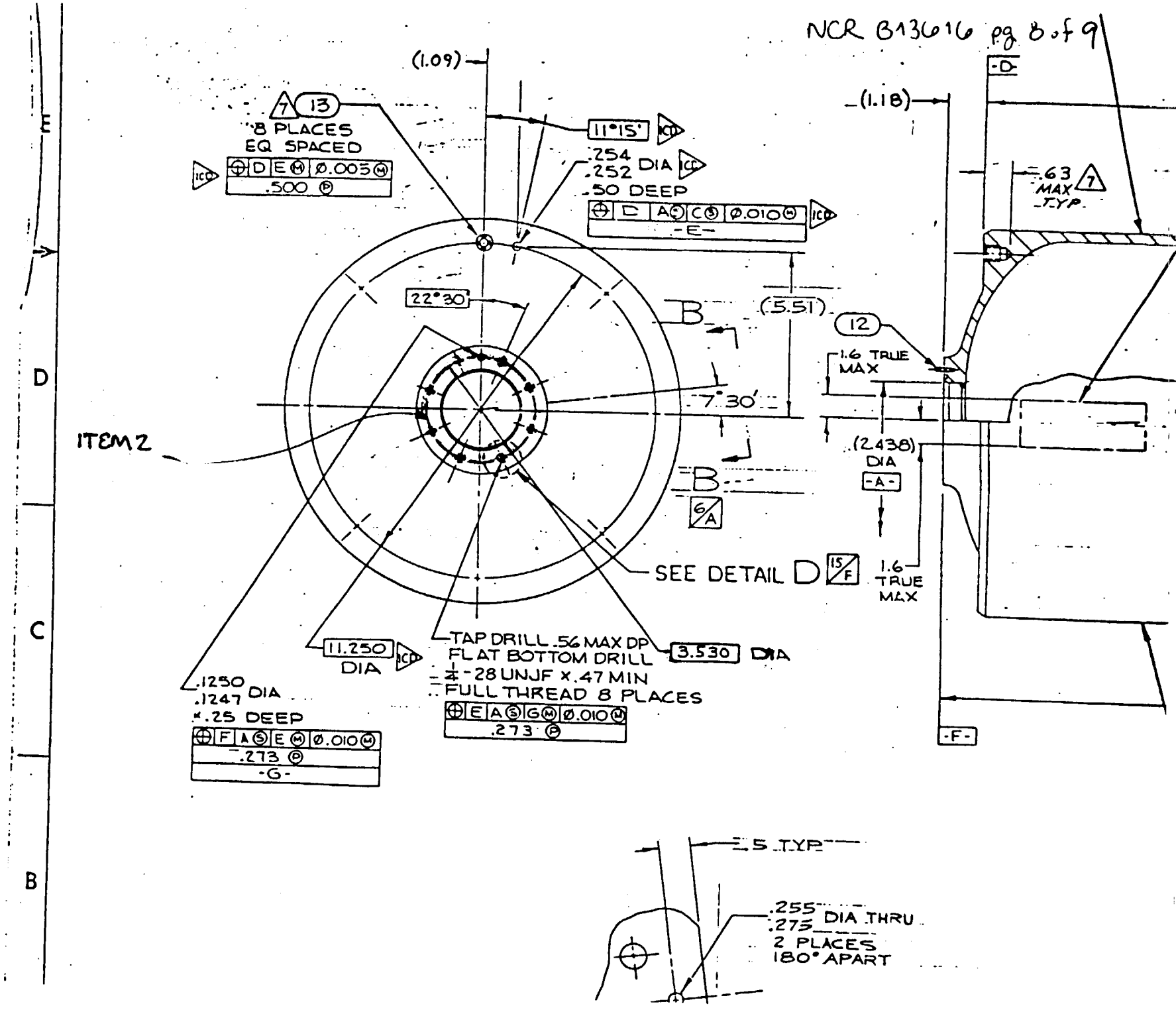
17 ITEM	18 OP NO	19 QTY AFFECTED	20 SERIAL NO	DISCREPANCY / APPLICABLE SPECIFICATIONS 21 DRWG / ZONE SPEC PARA	22 DIMENSION SPEC NOMINAL	23 TOLERANCE LIMITS	24 SET #	DESCRIPTION 1	2	3	4	5	25 DEFECT CODE	26 RESP ORGN	27 RECURR
							623	X							
							687	X							
							510	X							
							577	X							
							634	X							
							616	X							
							617	X							
							514	X							
							618	X							
							556	X							
							705	X							
							637	X							
							708	X		X					
							608	X							
							722	X							
							721	X							
							580	X							
							555	X							
							567	X							

* was 1 no 100

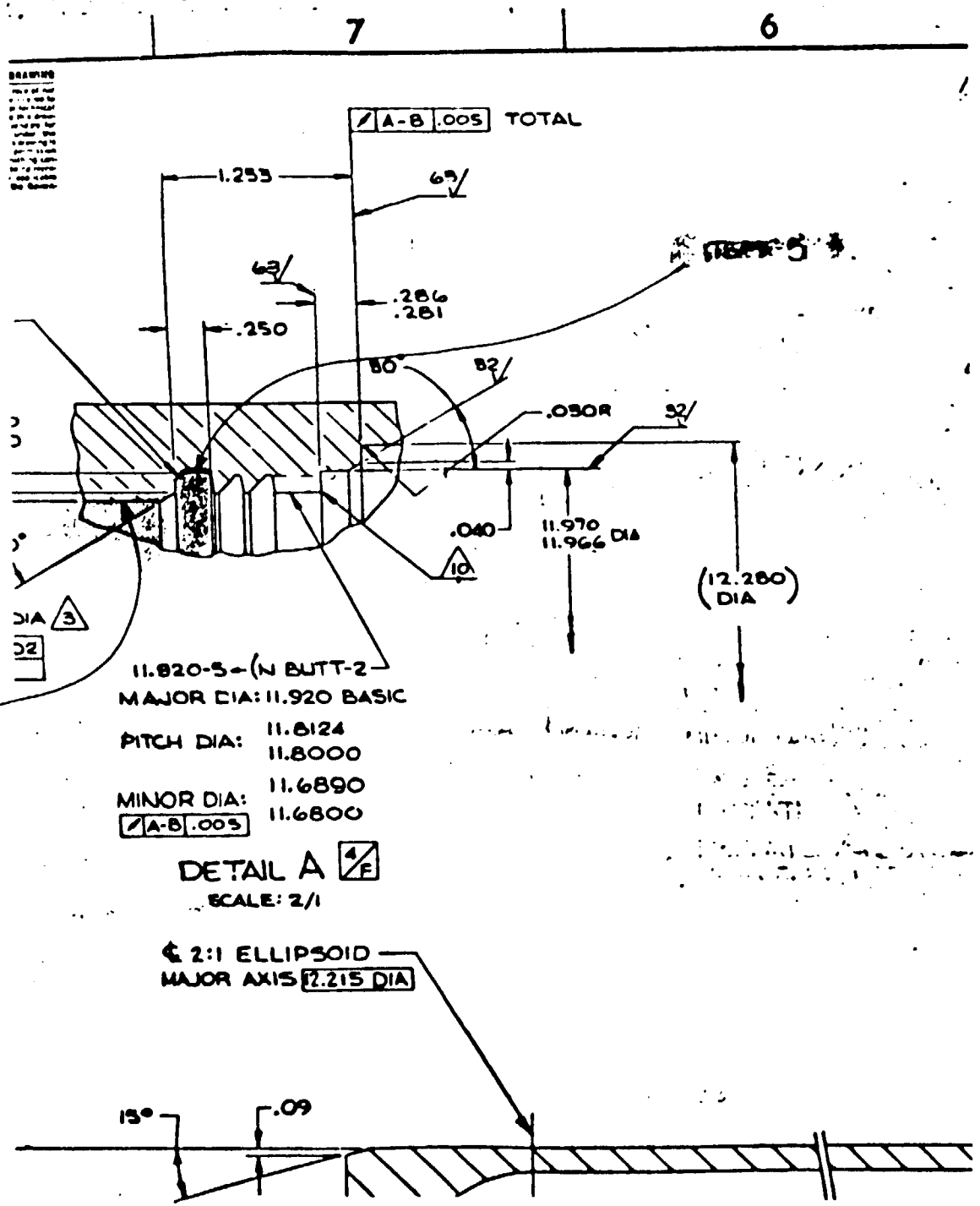
3 REFERENCE NO

599


SEE DETAIL A
MAJOR DIA: 11.9027 MAX
PITCH DIA: 11.75 / 11.7
MINOR DIA: 11.6461 MAX
C .002 TOTAL
.286
.281
32
.050 x 45°
.030 R
.19 R
30°30'
29°30'
8°30'
7°30'
11.057
10.985
DIA
11.566
11.564
DIA
A .010 TOTAL
C .002
-D-
.06 R
63
42°30'
41°30'
5.520
DIA
11.627
11.625
DIA
1.0
(4.22)
DIA
MAX
20°
(.670)
E F .005
TOTAL
4.900
DIA
5.455
DIA
11.536
11.530
DIA
5.500-6JN-2B
C (S) M A Ø.004 M
-F-
SEE DETAIL B
.969R
1.250R
.700
ITEM 2
FORGED
SURFACE
1.533
1.820
ITEM 4
10.725
10.695
3.170
C .010
.001
-E-


(1.09)
7 13
8 PLACES
EQ SPACED
D E M Ø.005 M
.500 P
11°15'
.254
.252 DIA
.50 DEEP
D A C S Ø.010 M
-E-
22°30'
B
(5.51)
7°30'
B
6/A
ITEM 2
SEE DETAIL D 15/F
11.250
DIA
TAP DRILL .56 MAX DP
FLAT BOTTOM DRILL
1/4-28 UNJF X .47 MIN
FULL THREAD 8 PLACES
E A S G M Ø.010 M
.273 P
3.530 DIA
.1250
.1247 DIA
.25 DEEP
F A S E M Ø.010 M
.273 P
-G-
(1.18)
-D-
.63 MAX TYP
7
12
1.6 TRUE MAX
(2.438)
DIA
-A-
1.6 TRUE MAX
-F-
.5 TYP
.255
.275 DIA THRU
2 PLACES
180° APART

NCR. B136168 pg 1 of 9

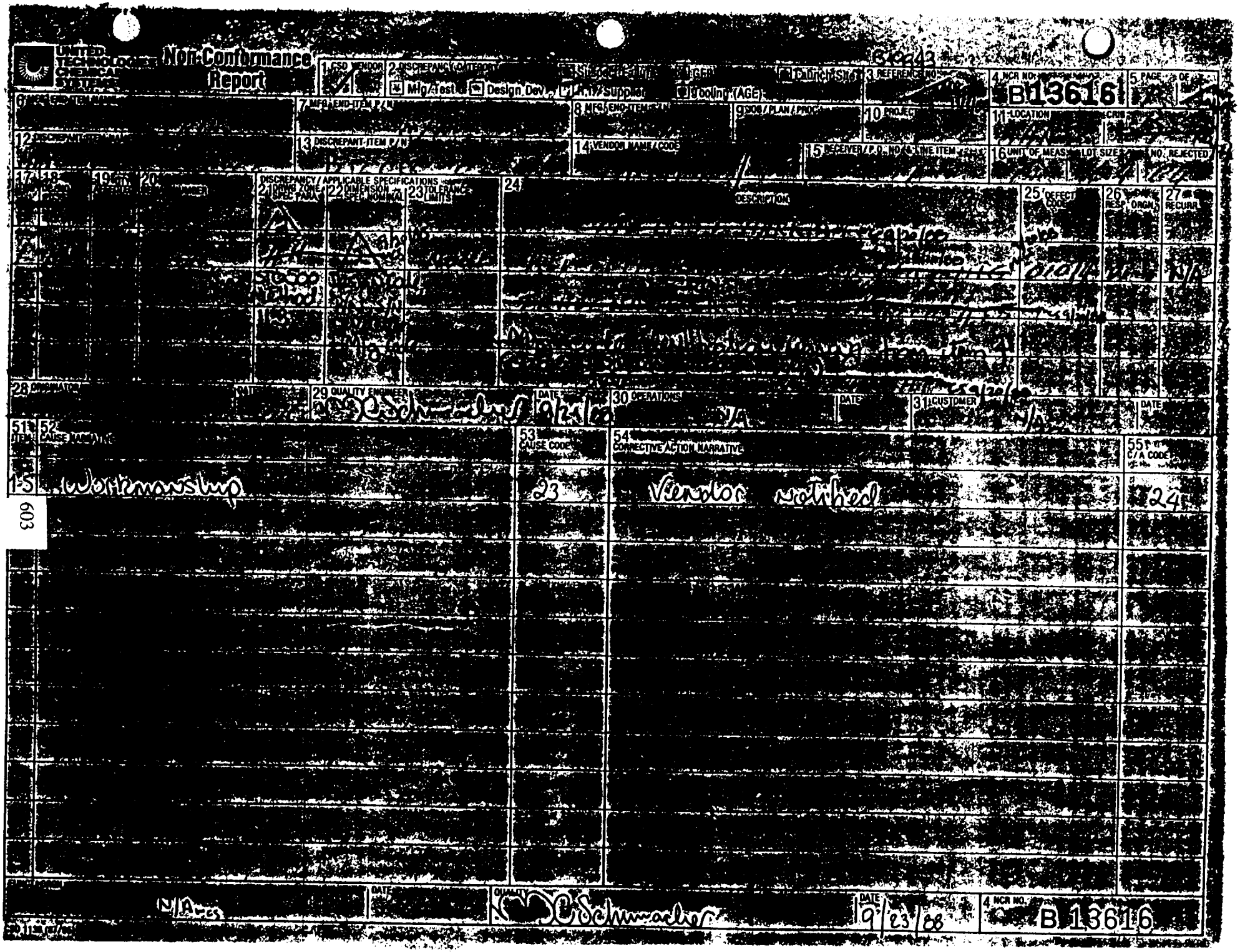


602

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UNITED TECHNOLOGIES CHEMICAL SYSTEMS

Non-Conformance Report

4 NCR NO. B13616

5 PAGE

6 MFG END-ITEM NAME

7 MFG END-ITEM P/N

8 MFG END-ITEM S/N

9 SOW / PLAN / PROC

10 PROJECT

11 LOCATION

12 DISCREPANT ITEM NAME

13 DISCREPANT ITEM P/N

14 VENDOR NAME / CODE

15 RECEIVER / P.O. NO. & LINE ITEM

16 UNIT OF MEAS. | LOT SIZE | NO. REJECTED

17 | 18 | 19 | 20

DISCREPANCY / APPLICABLE SPECIFICATIONS

21 ZONE

22 DIMENSION

23 TOLERANCE LIMITS

24 DESCRIPTION

25 DEFECT CODE

26 RESP. ORGN.

27 RECURR.

28 ORIGINATOR

29 QUALITY ENGINEER

DATE 9/21/88

30 OPERATIONS

DATE

31 CUSTOMER

DATE

51 ITEM	52 CAUSE FACTOR(S)	53 CAUSE CODE	54 CORRECTIVE ACTION NARRATIVE	55 C/A CODE
1-5	Workmanship	23	Vendor notified	24

603

N/A

DATE

QUALITY

DATE 9/23/88

4 NCR NO. B 13616

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AH-2-3 4/5/89

5593-lot-0900
5592-210

FWD AFT

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

Non-Conformance Report

1 CSD VENDOR ✓ | 2 DISCREPANCY CATEGORY: ☐ Mfg/Test ☐ Design Dev ☐ Suspect Failure ☑ R I /Supplier ☐ GFP ☐ Tooling (AGE) ☐ Launch Site | 3 REFERENCE NO 1313 | 4 NCR NO B 19943

6 MFG END-ITEM NAME	7 MFG END-ITEM P/N	8 MFG END-ITEM S/N	9 JOB/PLAN/PROC	10 PROJECT	11 LOCATION
N/A	N/A	SEE BLK 33	B17305	~~5332~~ 5592	SAN JOSE / 620

12 DISCREPANT ITEM NAME	13 DISCREPANT ITEM P/N	14 VENDOR NAME / CODE	15 RECEIVER/P O NO & LINE ITEM	16 UNIT OF MEAS	LOT SIZE
MATCHED SET CASE ASSY	B12018-02-01	THIEM IND / 04125	210397 - 2.00	EA	1 64 1 64

17 ITEM	18 OP NO	19 QTY AFFECTED	20 SERIAL NUMBER	DISCREPANCY / APPLICABLE SPECIFICATIONS: 21 DRWG ZONE SPEC PARA	22 DIMENSION SPEC NOMINAL	23 TOLERANCE LIMITS	24 DESCRIPTION	25 DEFECT CODE	26
1	N/A	64	SEE BLK 33	~~Δ~~ STD SPC ~~Authority TYPE III~~	Design Code P/N S/N ~~no letter~~ + Mfg Code	NONE	~~for letter ("E") omitted~~ * Mfg code missing from item 4 (B12018-13-01, Case Subassembly)	0014	VEND N/A
2	N/A	2	562 + 557	Δ	100% Cover Coat	NONE	Coating omitted from 11.5±.1 dia of S/N 562 and 13.5±.1 dia of S/N 557	13514	VEND

28 ORIGINATOR: D M Daley | DATE 11/1/88 | 29 QUALITY ENGINEER | DATE 11/1/88 | 30 OPERATIONS N/A | DATE | 31 CUSTOMER N/A

32 SUPPLIER ONLY INFO: DWG REV E; ECOs 29665

33 NARRATIVE: THIS NCR SUPERSEDES NCR B19016 TO ACCOMMODATE NMC REJECTION S/N/Serial NOs-(619)(623),543,666,641,578(665),649,636,724,(722)(656),704,515,643,521,(515),521,(573)(490),685,(515)(573),674,516,551,(714),529,(551),576,(644),726,666,(623)(665)(510),517,634,(610)(611),514,618,536,(665),(647),(729)(665),722,(721)(580),555 & (562). ALL S/Ns preceded by prefix I.
(*) Identification applies to item 4 only.) ALSO S/N's 540, 689, 511, (624)(512) 522, 657, 520, 562, 579, 526 AND 656.

34 C/A / PREV: ☐ No C/A ☐ CAR ☐ FRR ☑ C/A

35 ITEM	36 QTY	37 DISP CODE	38 ITEM DISPOSITION	39 OPERATIONS	40 QUALITY
			FINAL DISPOSITION ON NCR. DISPOSITION CONTINUATION SHEET.		

RECEIVED JUL 28 1989 N.M.O.

FILE COPY

41 DISPOSITION AUTHORITY: ☐ PR ☑ MRB ☐ Major

42 THIS DISPOSITION DOES NOT ADVERSELY AFFECT: ☒ Safety ☒ Weight ☒ Performance ☒ Reliability ☒

DISPOSITION APPROVALS

43 ENGINEERING [signature] DATE 4-4-89

44 OPERATIONS [signature] DATE 4-4-89

45 QUALITY ASSURANCE [signature] DATE 4-5-89

46 OTHER USBI: John Mack DATE 4/5/89

47 CUSTOMER AFDA: [signature] DATE 4-6-89

48 AFDA POST REVIEW DATE

IF A WAIVER IS GRANTED THE FOLLOWING STATEMENT APP—

604

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

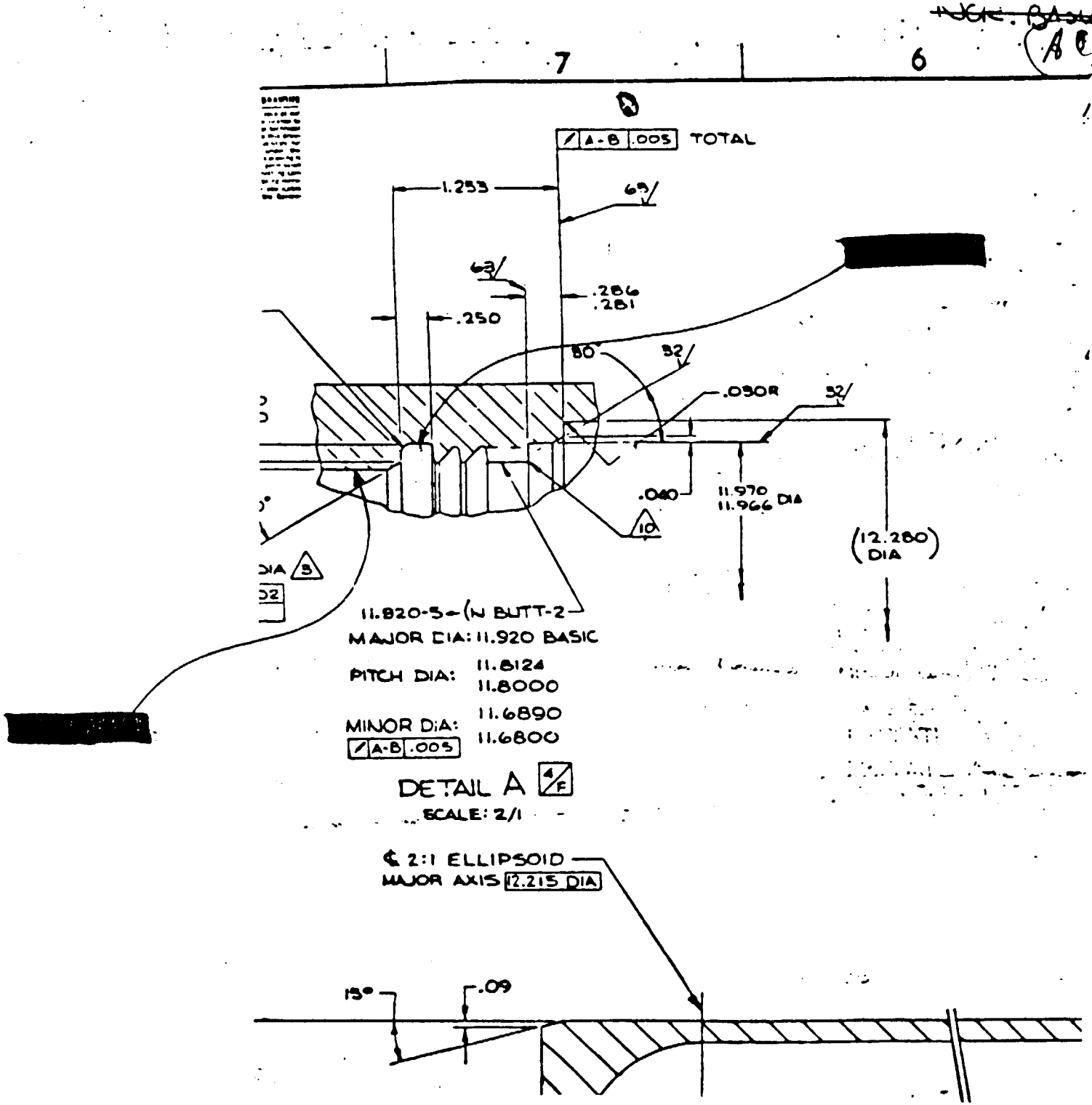
NCR Discrepancy
Continuation Sheet

12 DISCREPANT ID	13 DISCREPANT ITEM P/N	28 ORIGINATOR	DATE	4 REF / NCRNO	5 PAGE	OF
MATCHED SET, CASE-CLOSURE	B12018-02-01	MC Schumacher	11/1/68	~~B13616~~ B19443	2	6

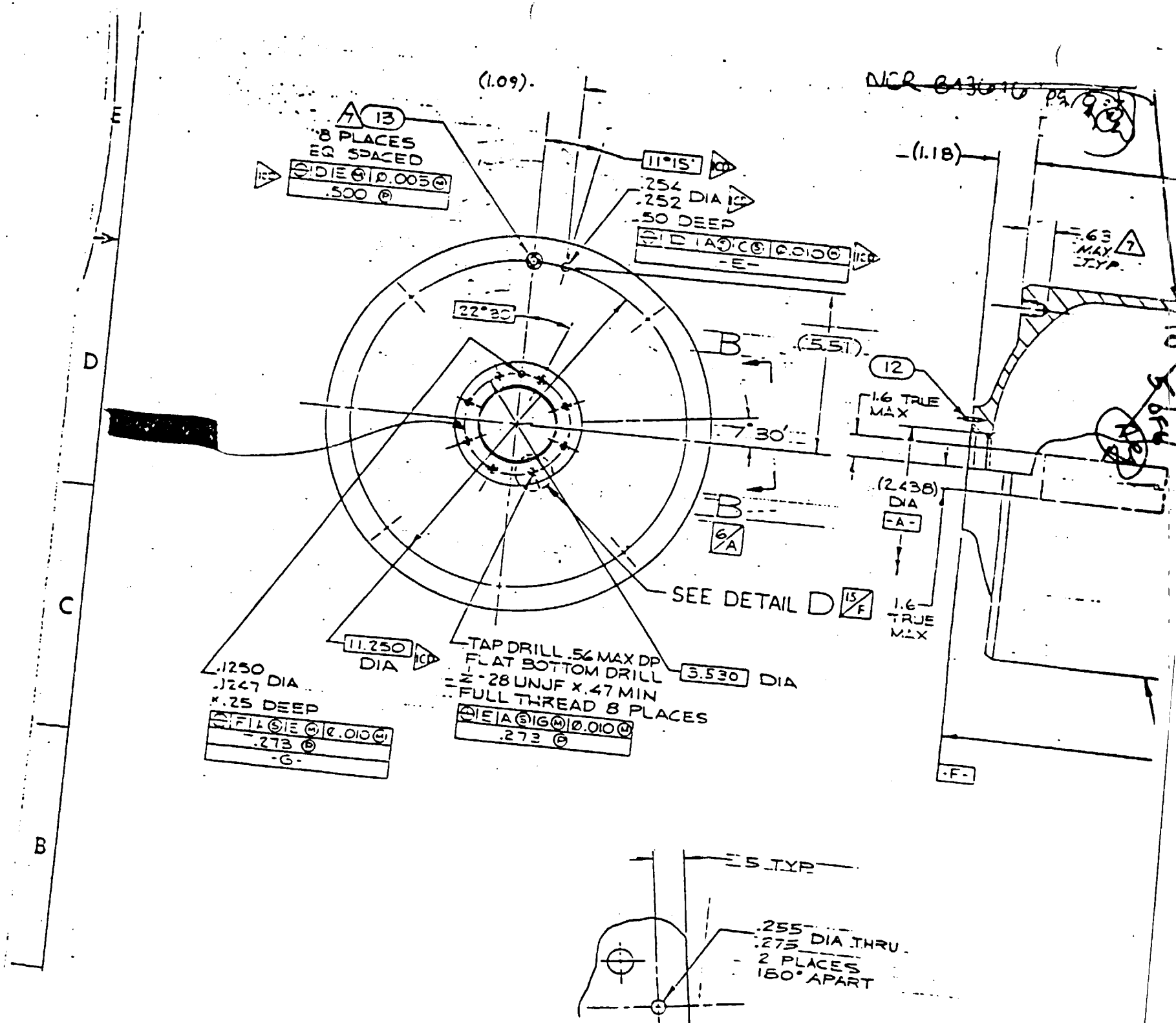
17 ITEM	18 OP NO	19 QTY AFFECTED	20 SERIAL NO	DISCREPANCY / APPLICABLE SPECIFICATIONS 21 DRWG, ZONE SPEC PARA	22 DIMENSION SPEC NOMINAL	23 TOLERANCE LIMITS	24 DESCRIPTION	25 DEFECT CODE	26 RESP ORGN	27 RECURR
3	N/A	3	657, 690 & 708	(3) of B12006 GIB	Free of tool marks, scratches	NONE	Nicks on O-ring surface at 120° (S/N 657) .35° (S/N 708) & 30° (S/N 690). Worst condition is 0.005dp locations are from dowel pin clockwise, aft looking fwd	25034	VEND	N/A
4	N/A	3	704, 526 & 595	6E B12006 (3)	"	"	Nicks on case to closure-threads	24534	VEND	N/A
5	N/A	1	520	BG Visual	125 ✓	MAX	Scratches on 11.954 dia, 0.005 dp, 360° around	25070	VEND	N/A

605

3 REFERENCE NO ~~B13616~~ B19443


7
6
D
A-B .005 TOTAL
1.253
63
63
.286
.281
.250
80°
32
.090R
32
.040
11.970
11.966 DIA
10
(12.280)
DIA
5
11.820-5-(N BUTT-2
MAJOR DIA: 11.920 BASIC
PITCH DIA: 11.8124
11.8000
MINOR DIA: 11.6890
11.6800
A-B .005
DETAIL A 4/F
SCALE: 2/1
℄ 2:1 ELLIPSOID
MAJOR AXIS 12.215 DIA
15°
.09

909


(1.09)
A 13
8 PLACES
EQ SPACED
DIE Ⓢ Ø.005 Ⓜ
.500 Ⓟ
11°15'
.254
.252 DIA
.50 DEEP
D 1A Ⓢ C Ⓢ Ø.010 Ⓜ
-E-
22°30'
B
(5.51)
12
1.6 TRUE MAX
7°30'
B
6/A
(2.438)
DIA
-A-
SEE DETAIL D 15/F
1.6 TRUE MAX
11.250
DIA
TAP DRILL .56 MAX DP
FLAT BOTTOM DRILL
2-28 UNJF x .47 MIN
FULL THREAD 8 PLACES
3.530 DIA
.1250
.1247 DIA
x .25 DEEP
F Ⓢ E Ⓜ Ø.010 Ⓜ
.273 Ⓟ
-G-
E Ⓢ A Ⓢ G Ⓜ Ø.010 Ⓜ
.273 Ⓟ
.63 MAX TYP
7
-F-
5 TYP
.255
.275 DIA THRU
2 PLACES
180° APART
E
D
C
B

UNITED TECHNOLOGIES

NCR Disposition
Continuation Sheet

12 DISCREPANT AE	13 DISCREPANT ITEM P/N	28 ORIGINATOR	DATE	4 REF / NCR NO	5 PAGE
MATCHED SET, CASE AFT CLOSURE	B12018-02-01	SONNY CHAN	12/2/88	B19943	6 of 16

35 ITEM	36 QTY	37 DISP CODE	38 ITEM DISPOSITION	39 OPERATIONS	40 QUALITY
			FINAL DISPOSITION†		
1	64	RWK	REWORK TO DRAWING REQUIRMENTS	JUN 13 1989	296 JUL 25 1989
2	2	RWK	REWORK TO DRAWING REQUIREMENTS	JUN 13 1989	296 JUL 25 1989
3	3	RP	REPAIR: RUN FINGER TO CHECK NICKED SURFACE FOR RAISED METAL. Q.C. found 2-14-89 REMOVE ANY FOUND BY HAND FILLING & BLENDING, THE OD AND ID OF O-RING GROOVE IS NOT AFFECTED AND WILL NOT AFFECT SEALING CAPABILITY OF O-RING SEAL. AFTER REPAIR TOUCH UP WITH ALODINE 1200 OR 1200S, RECORD QC TRACE # FOR ALODINE: QC3542	JUN 13 1989	296 JUL 25 1989
4	3	RP	REPAIR: CHECK FOR RAISED METAL ON NICKED AREAS AND REMOVE BY BLENDING. THE THREAD PITCH DIAMETER IS NOT AFFECTED. AFTER REPAIR, TOUCH UP WITH ALODINE 1200 OR 1200S, RECORD QC TRACE # FOR ALODINE QC3542	JUN 13 1989	296 JUL 25 1989
5	1	RP	REPAIR: REMOVE ANY RAISED METAL ON NICKED AREA BY BLENDING. 11.954 DIAMETER IS NOT VIOLATED AND WILL NOT AFFECT FIT OR FUNCTION OF PART. AFTER REPAIR TOUCH UP WITH ALODINE 1200 OR 1200S, RECORD QC TRACE # FOR ALODINE QC3542 4-5-89 4-3-89 4-5-89	JUN 13 1989	296 JUL 25 1989

MODIFY DRAFT AFQC 2-26-89

809

4 REF / NCR NO B19943

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

Non-Conformance Report

1 CSO VENDOR ✓ | 2 DISCREPANCY CATEGORY ☐ Mfg/Test ☐ Design Dev ☐ Supplier ☐ Failure ☐ GFP ☐ Launch Site ☐ Tooling (AGE) | 3 REFERENCE NO. B13046 | 4 NCR NO. B19[illegible]

6 MFG. END-ITEM NAME	7 MFG. END-ITEM P/N	8 MFG. END-ITEM S/N	9 JOB/PLAN/PROC.	10 PROJECT	11 LOCATION
N/A	N/A	SEE BLK 33	B17305	5332 5592	SAN JOSE

12 DISCREPANT ITEM NAME	13 DISCREPANT ITEM P/N	14 VENDOR NAME/CODE	15 RECEIVER/P.O. NO. & LINE ITEM	16 UNIT OF ISSUE	LOT SIZE
MATCHED ET. CASE - CLOSURE	B12018-02-01	THIEM IND/ 04125	210397 20	EA	CA

17 ITEM	18 OP NO.	19 QTY AFFECTED	20 SERIAL NUMBER	DISCREPANCY/APPLICABLE SPECIFICATIONS 21 DRWG ZONE SPEC PARA	22 DIMENSION SPEC NOMINAL	23 TOLERANCE LIMITS	24 DESCRIPTION	25 DEFECT CODE	26
1	N/A	64	SEE BLK 33	(2) S10000 ~~Interchange Rev letter~~ TYPE IID	Design Code P/N S/N ~~Rev letter~~ + Mfg Code	None	~~Rev letter ("E") omitted~~ + Mfg code missing from item 4 (B12018-13-02 Case Subassembly)	0214	
2	N/A	2	562 + 557	(2)	100% Cover Coat	None	Coating omitted from 11.340-11.360 dia of s/n 562 ~~1.330~~ dia of s/n 557	1351	

28 ORIGINATOR	DATE	29 QUALITY ENGINEER	DATE	30 OPERATIONS	DATE	31 CUSTOMER
for M Davis / C Schumacher	11/1/88	C Schumacher	11/1/88	N/A		NA

51 ITEM	52 CAUSE NARRATIVE	53 CAUSE CODE	54 CORRECTIVE ACTION NARRATIVE
1	~~See cause statement on superseded NCR B13046 attached~~	23	~~See CA statement on superseded NCR B13046 attached~~
1	WORKMANSHIP - E 23 4-4-89	23	VENDOR NOTIFIED E 23 4-4-89

FUNCT. ORGN. N/A DATE

QUALITY C Schumacher M.C. Salotti 4-4-89 DATE 11/1/88

4 NCR NO. B19[illegible]

SD 1138 (87/05)

609

AUTHORIZED FOR PUBLIC RELEASE BY THE OFFICE OF FOREIGN ASSETS CONTROL

NCR: D05044 PLANT: SJO DISC CAT: MT REF NO: PR/MRB: MRB WC/OB: REPORT DATE: 07/26/93 PAGE 1

DISC P/N	812016-02-02			NCR DATE:	05/30/91	INSPECTOR	ROBERT PICKERING 06/03/91
DISC P/NAME:	ADAPTER,IGNITER			DISPOSITION DATE:	12/20/91	VALIDATION	NATE TOEWS 06/07/91
MFG PART NO:	SAME			CLOSE DATE:	06/01/92	DISPOSITION	RAYMA RODRIGUEZ 12/20/91
MFG PART NM:	SAME			OPRO COMMENTS:	YES	CAUSE/CA (UTC)	RAY FRANKLIN 06/06/91
MFG SER NO:	N/A					CAUSE/CA (VEN)	N/A
PLAN REL:	MRA281499	UOM:	EA	PO:		QUAL DES ENGR	D.P. MCMAHON 12/23/91
PROJECT NO	5596	LOT SIZE:	99	VENDOR NO:	000000	CUSTOMER	JOHN MARTINEZ 12/23/91
BUILDING	6011	REJECT NO:	99	VEND NAME:		CUSTOMER	
WORK AREA:	PBS	CAR/FRR:		VEND DOC NO:		GOVT REP	RAYMOND CORREA 01/02/92
						MFG ENG REWORK	MARY DELANEY 01/07/92
						INSP ACCEPT	GERALDINE BARNES 06/01/92

NCR NARRATIVE

S/N ARE AS NOTED; 5465 THRU 5478, 5540 THRU 5551, 5554 THRU 5566, 5568 THRU 5574, 5576 THRU 5580, 5582 THRU 5599, 5625, 5627, 5629, 5630, 5633, 5635, 5641, 5661, 5663, 5668, 5674, 5678, 5679, 5696, 5697, 5136, 5152, 5328, 5340, 5357, 5372, 5382, 5401, 5409, 5460 THRU 5464, 6537. SJS 6-7-91 THIS NCR PREVIOUSLY APPROVED REPAIR OF CAD PLATE BY MRB NET 1-2-92

ITEM INFORMATION

ITEM:	OPER NO:	AFF QTY:	SERIAL NO:	DWG SPEC:	DEFECT CODE:	RESP ORGN:	OCC/REC:	DISP CODE:	DISP QTY
01	3	99	N/A	4-5/C	250 34	21833	000	RWK	99

DISCREPANCY & DISPOSITION

ITEM:	DISCREPANCY DESCRIPTION:	DISPOSITION DESCRIPTION:
01	SURFACE PLATING MARRED BY SCRATCHES TO 0.002 DEEP, WHEN CAD FINISH ON AREA SHOULD BE 100% PER NOTE 4, ECO 37475.	REWORK TO PRINT. APPROVED OUTSIDE VENDOR TO STRIP AND RE-PLATE THE ENTIRE SURFACE OF EACH PART IN ACCORDANCE WITH QQ-P-416, TYPE II, CLASS 2. RATIONALE: THE REWORK TO PRINT WILL RETURN THE PARTS TO THE DRAWING REQUIREMENTS.

CAUSE & CORRECTIVE ACTION

ITEM:	CAUSE CODE:	CAUSE NARRATIVE:	CA CODE:	CORRECTIVE ACTION NARRATIVE:
01	40	CAR GENERATED TO INVESTIGATE AND DETERMINE CAUSE.	40	CAR #04434 EXPECTED COMPLETION DATE 6/7/91.

610

NCR: D11910 PLANT: COY DISC CAT: MT REF NO: N/A PR/MRB: MRB WC/OB: REPORT DATE: 09/02/93

DISC P/N: B12003-10-01
DISC P/NAME: BSM NOZZLE ASSY.AFT QUAL
MFG PART NO: N/A
MFG PART NM: N/A
MFG SER NO: N/A
PLAN REL: MFGA 96733
PROJECT NO: 5597
BUILDING: 0020
WORK AREA: PBS

UOM: EA
LOT SIZE: 1
REJECT NO: 1
CAR/FRR:

NCR DATE: 07/26/93
DISPOSITION DATE: 08/02/93
CLOSE DATE: 08/06/93
DPRO COMMENTS: NO

PO: N/A
VENDOR NO: 000000
VEND NAME:
VEND DOC NO: N/A

INSPECTOR	MARK RADOVIC	07/26/93
VALIDATION	CAROL DANIELS	07/26/93
DISPOSITION	ARDEN EDWARDS	08/02/93
CAUSE/CA (UTC)	MARY DELANEY	08/03/93
CAUSE/CA (VEN)	N/A	
QUAL DES ENGR	CAROL DANIELS	08/03/93
CUSTOMER	PAUL LUNDY	08/03/93
CUSTOMER		
GOVT REP	RAYMOND CORREA	08/03/93
MFG ENG REWORK	MARY DELANEY	08/05/93
INSP ACCEPT	ADRIAN RANDLES	08/06/93

NCR NARRATIVE

ITEM INFORMATION

ITEM:	OPER NO:	AFF QTY:	SERIAL NO:	DWG SPEC:	DEFECT CODE:	RESP ORGN:	OCC/REC:	DISP CODE:	DISP QTY
01	D004	1	10705	D/12	250 58	21120	R	RP	1

DISCREPANCY & DISPOSITION

ITEM: 01

DISCREPANCY DESCRIPTION:
S/B:THE GAP FROM THE INSIDE SHOULDER OF THE CLOSURE TO THE TOP OF THE INSERT SHALL BE 0.002-0.004".
IS:THE GAP RANGES FROM 0.0005-0.001".

DISPOSITION DESCRIPTION:
REPAIR. RISPW UNAFFECTED. REPAIR BY ABRADING AFT FACE OF GRAPHITE THROAT INSERT USING 400 GRIT OR FINER EMERY CLOTH OR SANDPAPER TO ACHIEVE DRAWING REQUIRED .002-.004 DIMENSION. AFTER REPAIR, MEASURE AND RECORD THE STEP HEIGHT AT 60 DEGREE AZIMUTHS STARTING AT TDC. (CONT) VERIFY SURFACE FINISH MEETS REQUIREMENTS OF B12004-02-01 AND ALCOHOL WIPE TEST. NO CRACKS ALLOWED.
RATIONALE: THE .002-.004 STEP HEIGHT IS SPECIFIED TO PERMIT THERMAL EXPANSION OF THE NOZZLE MATERIALS DURING MOTOR OPERATION. BY REMOVING MATERIAL TO MEET THIS DIMENSION, SUFFICIENT ROOM WILL BE PROVIDED FOR THERMAL EXPANSION.

CAUSE & CORRECTIVE ACTION

ITEM:	CAUSE CODE:	CAUSE NARRATIVE:	CA CODE:	CORRECTIVE ACTION NARRATIVE:
01	11	BONDING TOOLING AS DESIGNED DOES NOT ALWAYS PRODUCE A PART WHICH MEETS THE 0.002"-0.004" DIMENSION.	11	CSD WILL CHANGE TOOL DRAWING AND HAVE TOOLS MODIFIED TO HAVE A STEP OF 0.0045"-0.005" INSTEAD OF 0.0035"-0.004".

NCR: D11923 PLANT: COY DISC CAT: MT REF NO: N/A PR/MRB: MRB WC/OB: REPORT DATE: 09/02/93 Page: 1

DISC P/N: 812003-10-01
DISC P/NAME: BSM NOZZLE QUAL 2
MFG PART NO: N/A
MFG PART NM: N/A
MFG SER NO: N/A
PLAN REL: MFGA96733
PROJECT NO: 5597
BUILDING: 0020
WORK AREA: PBS

UOM: EA
LOT SIZE: 1
REJECT NO: 1
CAR/FRR:

NCR DATE: 08/04/93
DISPOSITION DATE: 08/20/93
CLOSE DATE: 08/27/93
DPRO COMMENTS: NO

PO:
VENDOR NO: 000000
VEND NAME:
VEND DOC NO: N/A

INSPECTOR	ADRIAN RANDLES	08/04/93
VALIDATION	CAROL DANIELS	08/04/93
DISPOSITION	FREDERICK PAYNE	08/20/93
CAUSE/CA (UTC)	MARY DELANEY	08/20/93
CAUSE/CA (VEN)	N/A	
QUAL DES ENGR	MYRNA GARCIA	08/20/93
CUSTOMER	PAUL LUNDY	08/27/93
CUSTOMER		
GOVT REP	-N/A-	08/27/93
MFG ENG REWORK	N/A	08/27/93
PURCH BUYER	N/A	08/27/93
INSP ACCEPT	MARK RADOVIC	08/27/93

NCR NARRATIVE

SEE INTERIM DISPOSITION ATTACHED.MGG 7/29/93
INTERIM DISPOSITION #2. CD 7/30/93
INTERIM DISPOSITION #3. (CP) CD 8/4/93
SEE INTERIM DISPOSITION #4 - MK 8/17/93
SEE VMRR 006184 FOR DISPOSITION AUTHORITY. MK 8/20/93
SEE ATACHED INTERIM DISPOSITION # 5 TO CONTINUE PROCESSING.MGG 8/23/93
VMRR APPROVED. CD 8/27/93

ITEM INFORMATION

ITEM:	OPER NO:	AFF QTY:	SERIAL NO:	DWG SPEC:	DEFECT CODE:	RESP ORGN:	OCC/REC:	DISP CODE:	DISP QTY
01	MAT0030	1	I0705	SE2073 3.3.1.2	510 14	21100	R	A	1
02	MAT0030	1	I0705	SE2073 3.3.10	335 58	21100	R	A	1
03	MAT0030	1	I0705	SE20733.2.2	335 29	21100	R	A	1
04	MAT0030	1	I0705	12003 NOTE/47	125 12	21100	R	0	1

DISCREPANCY & DISPOSITION

ITEM: DISCREPANCY DESCRIPTION:

01 S/B:ALL SURFACE PREPARATIONS,ADHESIVE APPLICATIONS ACTIVITIE S SHALL BE PERFORMED IN A DESIGNATED BONDING ROOM.
IS:THE INSULATION WAS NOT BONDED INSIDE BONDING ROOM.

DISPOSITION DESCRIPTION:
USE-AS-IS. RISPW UNAFFECTED. THE ACCEPTABLE RESULTS OF THE TESTING AND INSPECTIONS PERFORMED IN ACCORDANCE WITH INTERIM DISPOSITIONS #1-4 SHOW THE INSULTOR-TO-CLOSURE BOND IS ACCEPTABLE. THE BOND TEST PANEL WHICH WAS CO-PROCESSED WITH THE DELTA QUALIFICATION AFT CLOSURES (CONT.)
EXHIBITED ACCEPTABLE RESULTS OF 89 PLI WHICH ARE FAR IN EXCESS OF THE MINIMUM REQUIREMENT OF 25 PLI. IN ADDITION, THE FAILURE MODE OF THE PANEL WAS COHESIVE IN THE RUBBER. THIS MEANS THE BOND STRENGTH IS GREATER THAN THE RUBBER STRENGTH WHICH SHOWS THE EXCELLENT QUALITY OF THE BOND. THE ULTRASONIC AND TAP INSPECTION SHOWED NO UNBONDS WHICH CONFIRMS THE BOND QUALITY. TOGETHER, THE ACCEPTABLE AND EXCELLENT RESULTS OF THE CO-PROCESSED PEEL PANEL, ULTRASONIC INSPECTION AND TAP INSPECTION SHOWS THAT THE BOND PROCESS NOT BEING PERFORMED IN A DESIGNATED BOND ROOM HAD NO EFFECT ON THE BOND QUALITY.
USE-AS-IS. RISPW UNAFFECTED. SEE ITEM 1 FOR RATIONALE.

02 S/B:VACUUM SHALL BE HELD ON CLOSURE INSULATORS FOR A MIN. OF 12HRS PRIOR TO BEGINNING OF CURE CYCLE.AFTER HOLD,THEPART MAY NOT BE WITHOUT VACUUM MORE THAN 2 HRS.ALL PARTS SHALL

BE HELD UNDER A MINIMUM VACUUM OF 22 INCHES.
IS:CHART HAS ILLEGIBLE READINGS FOR APPROX.5HRS13MIN

03 S/B:NON SILICONE TAPES SHALL BE USED.
IS:TAPES USED ARE NOT CERTIFIED FOR SILICONE CONTENT.

USE-AS-IS. RISPW UNAFFECTED. THE INNER AND OUTER INSULATOR BOND EDGES WERE INSPECTED IN ACCORDANCE WITH DRAWING REQUIREMENTS. THE BONDLINE CONDITION WAS ACCEPTABLE WITH NO CONDITIONS REQUIRING REWORK WITH ADHESIVE. THE INSULATOR EDGES ARE IMMEDIATELY ADJACENT TO THE AREAS THAT (-->) ARE MASKED WITH TAPE DURING PROCESSING. THE ACCEPTABLE EDGE BOND CONDITION DEMONSTRATES THAT THE USE OF NON-CERTIFIED TAPES DID NOT ADVERSELY AFFECT THE BOND.
OTHER. RISPW UNAFFECTED. THE RAISED MATERIAL WAS REMOVED IN ACCORDANCE WITH INTERIM DISPOSITION #4 AND THE ULTRASONIC INSPECTION PERFORMED PER APPROVED REPAIR PLANNING. THE REMOVAL WAS ACCOMPLISHED SUCCESSFULLY WITH NO GOUGES OR DEPRESSIONS CREATED IN THE INSULATOR SURFACE. THE (CONT) ULTRASONIC INSPECTION WAS ACCEPTABLE WITH NO UNBONDS NOTED.

04 S/B:ULTRASONIC INSECTION OF BONDING AREA.
IS:NDT INSPECTION OF INSULATOR BOND AREA WAS PERFORMED. NO UNBONDS NOTED IN AREAS INSPECTED.ONE AREA,FROM 210DEG TO 150DEG,WHERE NDT INSPECTION CANNOT BE PERFORM DO TO A CIRCUMFERENTIAL SURFACE RIDGE UP TO 0.1"WIDE,(SEE EXPANS) X 0.06 HIGH ON INSULATOR SURFACE.

CAUSE & CORRECTIVE ACTION

ITEM:	CAUSE CODE:	CAUSE NARRATIVE:	CA CODE:	CORRECTIVE ACTION NARRATIVE:
01	40	SEE USBI CAR #659.	40	SEE USBI CAR #659.
02	11	DURINGVACUUM HOLD, VACUUM CHART BECAME JAMMED FOR A PEROID OF TIME. NO OVEN WATCH WAS AVAILABLE.	11	VACUUM RECORDER WAS CLEANED AND PUT BACK INTO SERVICE. DATA BEFORE AND AFTER INDICATED THAT VACUUM WAS HELD. OVEN WATCH WILL BE SCHEDULED DURING AUTOCLAVE OPERATION TO VERIFY PRINTER IS RECORDING.
03	40	SEE USBI CAR #659.	40	SEE USBI CAR #659.
04	11	THE RIDGE IN THE AFT CLOSURE INSULATION OF THE DELTA QUALIFICATION ASSEMBLIES WAS CAUSED BY AN EXCESSIVE AMOUNT OF BLEEDER CLOTH WHICH WAS PLACED IN THE VACUUM BAG OVER THE INSULATOR FORMING DONUT (REF.SK-MFP081993-1). AS CAN BE SEEN IN THE SKETCH, THE EXCESSIVE BLEEDER CLOTH WAS UNABLE TO PROPERLY PULL DOWN INTO THE CORNER WHICH LEFT A SPACE. THIS SPACE SUBSEQUENTLY FILLED WITH RUBBER UNDER HEAT AND PRESSURE OF THE AUTOCLAVE CURL WHICH FORMED A RIDGE IN THE INSULATION.	11	THE CORRECTIVE ACTION WILL BE TO CONTROL THE AMOUNT OF BLEEDER CLOTH INSTALLED IN THE VACUUM BAG. ONLY TWO LAYERS OF NYLON RELEASE CLOTH WILL BE USED OVER THE FORMING DONUT.THIS METHOD OF BAGGING IS SIMILAR TO THAT USED ON THE DEMOSTRATION UNITS. THE DEMOSTRATION UNITS WERE COMPLETELY ACCESSIBLE TO NDT INSPECTION IN THE AREA WHERE THE RIDGE FORMED ON THE DELTA QUALIFICATION UNITS. THIS CORRECTIVE ACTION WILL BE CONFIRMED BY THE FABRICATION OF ONE ADDITIONAL DEMOSTRATION UNIT. THE NOZZLE ASSEMBLY PRODUCTION PLANNING FOR LOT ABA WILL THEN BE REVISED TO CONTROL THE AMOUNT OF BLEEDER CLOTH INSTALLED AND A PICTORIAL DEPICTION OF THE PROPER BAGGING TECHNIQUE WILL BE ADDED. TRAINING SESSIONS WILL BE CONDUCTED AND DOCUMENTED TO INSURE OPERATORS WHO PERFORM INSULATION VULCANIZATION PROCESSES ARE KNOWLEDGEABLE REGARDING PLANNING AND PROCESS REQUIREMENTS. THE NOZZLE ASSEMBLY DRAWINGS WILL BE REVISED TO SPECIFY THE ALLOWED POST-VULCANIZATION CONTOUR OF THE INSULATOR.

UNITED TECHNOLOGIES USBI

PAGE 1 OF 8

VMRR NO. 006184

VENDOR MATERIAL REVIEW REPORT

1 PART NAME	2 PART/SPEC NO	3 DASH NO	4 REV	5 ECO NO	6 USBI SERIAL/LOT NO	7 LOT SIZE	8 QTY ACC	9 QTY REJ	10 UNIT
NOZZLE ASSEMBLY FT QUAL 2	B12003-10	01	#1	5594-00232	F0705	1	0	1	EA

11 PO NO	12 ITEM	13 WOR NO	14 VENDOR NAME AND ADDRESS	15 VENDOR ID NO	16 DATE
018333	N/A	4052-501-0000	UTC/CSD P.O. Box 49028 SAN JOSE, CA 95161-9028	30120	8/19/93

17 ITEM NO	18 QTY	19 DWG ZONE SPEC PAR	20 DWG/SPEC REQ (INCLUDE TOLERANCE)	21 NONCONFORMANCE/DESCRIPTION OF TROUBLE (ACTUAL READING OR CONDITION)
1	1	3.3.1.2	SE2073	S/B: ALL SURFACE PREPARATIONS, PRIMER AND ADHESIVE
		Bonding	Rev. Basic	APPLICATIONS, MATING OF INSULATOR TO CLOSURE AND
		Room		TEMPORARY STORAGE ACTIVITIES SHALL BE PERFORMED IN A
				DESIGNATED Bond Room.
				IS: THE INSULATOR TO CLOSURE PREPARATIONS, PRIMER
				AND ADHESIVE APPLICATIONS, AND MATING OF INSULATOR
				TO CLOSURE WERE NOT PERFORMED INSIDE THE BONDING ROOM
				REF: CSD NCR D11923

22. REPETITIVE NONCONFORMANCE 8-19-93 TWX NO ☒ YES ☐ TIMES IN 1 MONTH VMRR NO. 006185

NATURE OF NONCONFORMANCE AND CORRECTIVE ACTION TAKEN TO PREVENT RECURRENCE

SEE ATTACHMENT I FOR CAUSE AND CORRECTIVE ACTION FOR ITEM NO's. 1, 2 & 3 (Item 3 8-19-93)
REFERENCE USBI CAR 659
SEE ATTACHMENT II FOR CAUSE AND CORRECTIVE ACTION FOR ITEM NO. 4
SEE ATTACHMENT III FOR CAUSE AND CORRECTIVE ACTION FOR ITEM 2. AS SPECIFIED IN NCR D11923

24. FAILURE REPORT	25. EFFECTIVITY OF CORRECTIVE ACTION SN OR DATE	26. CONFIRMING TWX
☒ NO ☐ YES REPORT NO.	LOT ABA	☒ NO ☐ YES TWX NO.

27. [illegible] DCMC	DATE 9/24/93	28. QUALITY CONTROL SUPERVISION M. Kubik	DATE 8/20/93	29. USBI REPRESENTATIVE	DATE 8-20-93

SPACE BELOW RESERVED FOR USBI

30 ITEM NO	31 QTY	32 ORGN RESP	33 DISP CODE	34 DISPOSITION INSTRUCTIONS (☐ PRELIMINARY REVIEW ☒ MATERIAL REVIEW BOARD)	35 QC ACCEPT
1,2,3	1	V	A	USE AS IS. SEE PAGE 5 FOR RATIONALE.	USBI 93
4	1	V	B	REWORK TO PRINT. SEE PAGE 5 FOR RATIONALE AND DIRECTION. 9-2-93	USBI 93

ADDITIONAL CORRECTIVE ACTION REQUIREMENTS IF ANY

37 QUALITY ENGINEER	DATE	38 ENGINEERING REPRESENTATIVE	DATE	39 CUSTOMER APPROVAL	DATE
Edward J. Bubley	8-26-93	Donald L. Duke	8/25/93	John M. Reese DCMC 27 Aug 93	

USB 1453 (88/01)

UNITED TECHNOLOGIES USBI

VMRR (Continuation Sheet)

1. VMRR No. 006184

Page 2 of 52

Date	3. Part Name	4. Part or Spec No.	5. Dash No.	6. Rev	7. E.C.O. No
19-93	AFT NOZZLE ASSEMBLY QUAL 2	B12003-10	01	*1	5594-00222

8. Item No.	9. Qty	10. Drawing Zone Spec. Para	11. Drawing and Spec. Req (to include tolerance)	12. Nonconformance and Description of Trouble (actual reading or condition)
2	1	3.3.10	SE2073	S/B: VACUUM SHALL BE HELD ON CLOSURE INSULATOR
		VACUUM	REV. BASIC	FOR A MINIMUM OF 12 HOURS PRIOR TO BEGINNING
		BAGGING		OF CURE CYCLE. AFTER HOLD, THE PART MAY NOT BE
				WITHOUT VACUUM MORE THAN TWO HOURS. ALL PARTS
				SHALL BE HELD UNDER A MINIMUM VACUUM OF 22 INCHES
				IS: VACUUM RECORDER CHART HAS ILLEGIBLE
				VACUUM READINGS FOR APPROXIMATELY 5 HOURS 15 MINUTES.

Add Graphs – Illustrations etc. As Required

13. ~~Quality Control Inspector~~ DCMC	Date	14. Quality Control Supervisor	Date	15. USBI Representative	Date
Nadine Calley	8/20/93	D. L. Fussell	8/20/93	Lynn Lockhart	8-20-93

USBI To Complete Below

☐ Preliminary Review ☐ Material Review Board

16. Item No.	17. Qty	18. Org Resp	19. Disposition Instructions	20. Disp Code	21. QC Accept

22. Quality Engineer	Date	23. Engineering Representative	Date	24. Customer Approval	Date
Edward J. Buckley	8-26-93	Vincent L. Burke	8/25/93	John M. Thomas DCMC DAE	27 Aug 93

USB 1453A (91/09)

UNITED TECHNOLOGIES USBI

VMRR (Continuation Sheet)

1. VMRR No. 006184

Page 3 of 623

Date	3. Part Name	4. Part or Spec No.	5. Dash No.	6. Rev	7. E.C.O. No.
9-93	NOZZLE ASSEMBLY AFT. QUAL 2	B12003-10	01	*1	5584-00233

8. Item No.	9. Qty	10. Drawing Zone Spec. Para	11. Drawing and Spec. Req (to include tolerance)	12. Nonconformance and Description of Trouble (actual reading or condition)
3	1	3.2.2	SE2073	S/B: NON-SILICONE TAPES SHALL BE USED.
		MASKING	REV. BASIC	I.S.I TAPES USED FOR MASKING ARE NOT CERTIFIED
		TAPES		FOR SILICONE CONTENT

Add Graphs – Illustrations etc. As Required

13. ~~Quality Control Inspector~~ DCMA — Date 8/20/93

14. Quality Control Supervisor — Date 8/20/93

15. USBI Representative — Date 8-20-93

USBF To Complete Below

16. Item No.	17. Qty	18. Org Resp	19. Disposition Instructions ☐ Preliminary Review ☐ Material Review Board	20. Disp Code	21. QC Accept

22. Quality Engineer — Date 8-26-93

23. Engineering Representative — Date 8/25/93

24. Customer Approval, DCMC GAE — Date 8 AUG 93

USB 1453A (91/09)

Item: 1, Qty: 1

Use-as-is for qualification testing. The requirement for performing adhesive bonding operation inside a bonding room is intended to insure that no contamination degrades the mechanical bond. The peel test samples, which were co-processed in the same area as the closure insulators, yielded acceptable bond strength values well above the 25 pli minimum requirement. (ATTACH These test samples provide confidence that the insulator to closure vulcanized bond has adequate strength.

Item: 2, Qty: 1

Use-as-is for qualification testing. The 12 hour vacuum hold period is a process control requirement to insure that entrapped air between the closure and the insulator is removed. Entrapped air could potentially cause an unbond in the interface. The post-vulcanization inspection of the bondline (ultrasonic and tap test) verified that there are no unbonds between the insulator and closure. Therefore there is no hardware discrepancy.

Item: 3, Qty: 1

Use-as-is for qualification testing. The requirement for non-silicone tapes is intended to preclude silicone contamination of the adhesive bond. The tape used was applied to the threads of the closure which is not part of the bond area. Adequate bonding was achieved as shown by the closure/insulator edge bond inspection. The use of the silicone tape will provide for qualification of a more worse case condition that what will exist in flight motors.

Item: 4, Qty: 1

Rework to print by removing the raised area and re-inspecting via ultrasonic inspection and tap test. Use Non-Conformance Rework/Repair Planning for NCR D11923 ~~(attached)~~ (ATTACHMENT V)

Regenia L. Burke 8/25/93
USBI Engineering

Ronald S. Veal 8-20-93
USBI Engineering

Edward J. Buckley 8-26-93
USBI Quality

John M. Reiss
DCMC QE
27 Aug 93

USBI 93 SOURCE INSP
9-3-93

RESPONSE TO USBI CAR 659

CAUSE:

The documented discrepancy is a first time occurrence. Insulated closures P/N B12003-09-01, S/N W0442 (FWD), Release Number MFGA 96732, and P/N B12003-10-01, S/N I0705, (AFT), Release Number MFGA 96733, were being processed per Material Acceptance Traveler (MAT) operation 0030 to bond rubber insulator to metal closure per SE 2073 as part of the Delta Qualification Program. Peel 180° panel was processed in the same environment as the two closures. Paragraph 3.3.1.2 requires surface preparation, priming, adhesive applications, mating of parts and the temporary storage activities to be completed in a "designated" bonding room. The BSM designated bonding room was not utilized as required for the two referenced closure assembly bonding activities prior to vacuum hold and autoclave cure.

The masking tape employed as part of bonding activities contained no identification that allowed verification of a "Silicone-Free" material, violating paragraph 3.2.2 of specification SE 2073. The masking tape used in the two Delta qualification units was the same as used for the demonstration units and is CSD #80031. No part number identification was on the roll of tape. Verification of the support material is obtained via part master description. No certification of the silicone content of the tape was available at the time of operational use. Verification that the tape is "Silicone-Free" has been obtained (see attached) from the manufacturer.

The requirement to perform specific tasks within the designated bond room and verification of "Silicone-Free" masking tape was overlooked by the CSD engineer and operators (Quality inspection is not required by the approved planning to witness the operation in question) present at the time the operation was proceeding. The inspector does have mandatories within the planning package, however was performing other duties in a separate location on site while the bonding operation was being performed. PI 07.2.048.0 calls out the bond room requirement (see attached) under Item 10 of the prerequisites. Demonstration units were bonded in the same general area as the two Delta qualification units. The operation occurred on a Sunday while very little other activity was underway within the station.

CORRECTIVE ACTION:

Nonconformance reports, D11923 and D11927, were written to document the discrepancies described above and allow for Material Review Board (MRB) disposition. The following actions are being taken to correct the errors and prevent re-occurrence.

1) Process Instruction (PI) 07.2.048.0 has been revised per Planning Change Sheet (PCS) No. 040487 (see attached) to identify by CSD part number on the support materials list and within the body of the instruction at the masking operations the "Silicone-Free" tape that was used for the two Delta qualification units and will be for all future production parts. A second "Silicon-Free" masking tape has been called out as a back-up.

ATTACHMENT 2
VMRR 4/06/94
1-29. 7 of 4

RESPONSE TO USBI CAR 659
(Continued)

2) Data Acceptance Record (DAR) items have been added per PCS No. 040487 to require stamped verification that the designated bond room and masking tape(s) have been used to process the hardware.

3) Identification tags with CSD Part Number, Lot Number, and Quality Inspection Stamp will be required on the appropriate rolls of masking tape.

4) Manufacturer's Certificate of Conformance have been added to the Receiving Inspection Packages (RIP) to document the masking tape used for the two Delta qualification units and future production units is "Silicone-Free".

5) A storage area within the BSM adhesive bonding room to store the selected masking tapes has been established.

6) Part master descriptions for CSD part numbers have been updated to require a certification of "Silicone-Free" material for any future orders.

7) A training session to detail the BSM insulated closure bonding process, with emphasis on the bond room and tape requirements, has been completed (see attached attendance sheet). Operators will complete a formal training session prior to performing bonding operations.

8) Review of the igniter and loaded motor assembly and paperwork shall be conducted prior to commencing bonding operations to ensure compliance to design requirements. The review shall be completed by CSD Quality, Manufacturing, and Design representatives. PCS's shall be issued per CSD Standard Procedure 50.23.12, to incorporate any required document changes.

CAUSE:

The ridge in the aft closure insulation of the Delta Qualification nozzle assemblies was caused by an excessive amount of bleeder cloth which was placed in the vacuum bag over the insulator forming donut (ref. SK-FMP081993-1). As can be seen in the sketch, the excessive bleeder cloth was unable to properly pull down into the corner which left a space. This space subsequently filled with rubber under the heat and pressure of the autoclave cure which formed a ridge in the insulation.

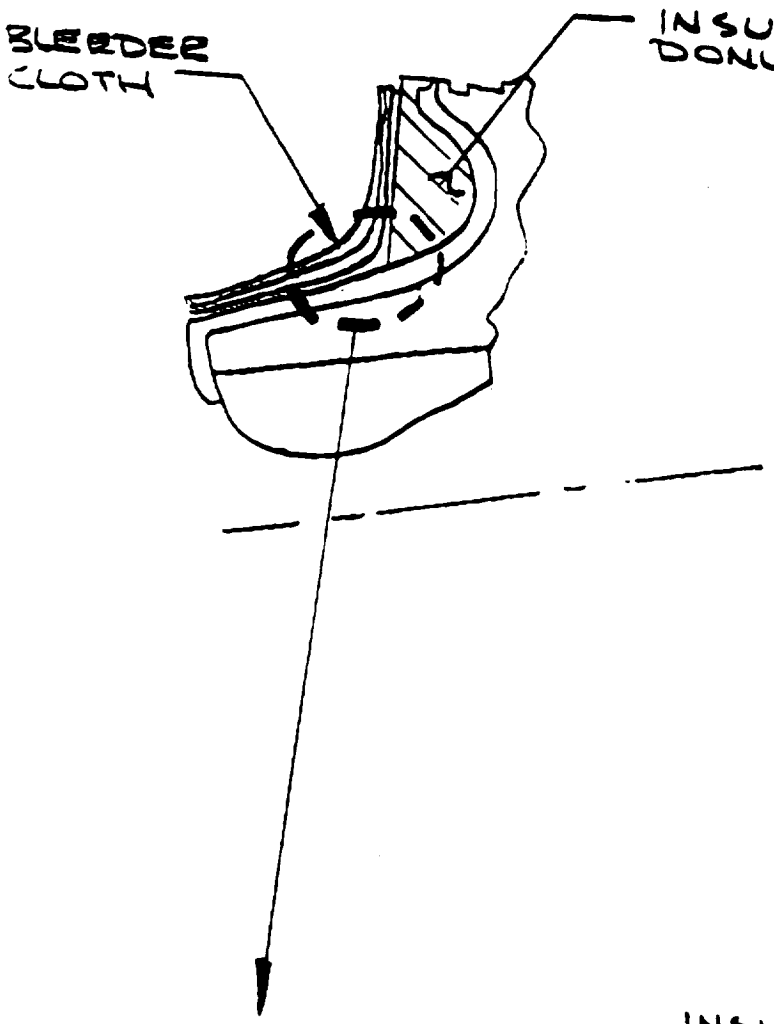
CORRECTIVE ACTION:

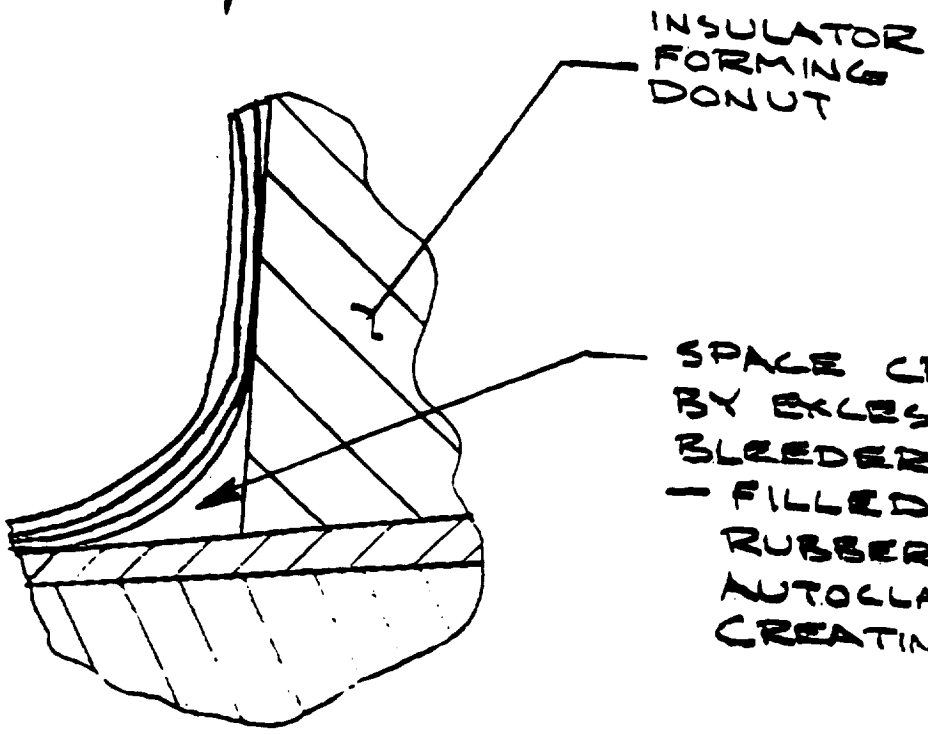
The corrective action will be to control the amount of bleeder cloth installed in the vacuum bag. Only two layers of nylon release cloth will be used over the forming donut. This method of bagging is similar to that used on the demonstration units. The demonstration units were completely accessible to NDT inspection in the area where the ridge formed on the Delta Qualification units. This corrective action will be confirmed by the fabrication of one additional demonstration unit. The nozzle assembly production planning for lot ABA will then be revised to control the amount of bleeder cloth installed and a pictorial depiction of the proper bagging technique will be added. Training sessions will be conducted and documented to insure operators who perform insulation vulcanization processes are knowledgeable regarding planning and process requirements. The nozzle assembly drawings will be revised

ATTACHMENT II
VMA 0126.54

to specify the allowed post-vulcanization contour of the insulator.

CROSS SECTION OF NOZZLE ASSEMBLY
W/ FORMING DONUT & BLEEDER CLOTH





SK-FMP081993-1

NCR: D11923 PLANT: CDY DISC CAT: MT REF NO: N/A PR/MRB: MRB UC/DB: REPORT DATE: 08/26/93 PAGE: 1

DISC P/N: B12003-10-01
DISC P/NAME: BSM NOZZLE QUAL 2
MFG PART NO: N/A
MFG PART NM: N/A
MFG SER NO: N/A
PLAN REL: MFGA96733
PROJECT NO: 5597
BUILDING: 0020
WORK AREA: PBS

UOM: EA
LOT SIZE: 1
REJECT NO: 1
CAR/FRR:

NCR DATE: 08/04/93
DISPOSITION DATE: 08/20/93
CLOSE DATE:
OPRO COMMENTS: NO

PO:
VENDOR NO: 000000
VEND NAME:
VEND DOC NO: N/A

INSPECTOR	ADRIAN RANDLES	08/04/93
VALIDATION	CAROL DANIELS	08/04/93
DISPOSITION	FREDERICK PAYNE	08/20/93
CAUSE/CA (UTC)	MARY DELANEY	08/20/93
CAUSE/CA (VEN)	N/A	
QUAL DES ENGR	MYRNA GARCIA	08/20/93
CUSTOMER		
CUSTOMER GOVT REP		

NCR NARRATIVE

SEE INTERIM DISPOSITION ATTACHED.MGG 7/29/93
INTERIM DISPOSITION #2. CD 7/30/93
INTERIM DISPOSITION #3. (CP) CD 8/4/93
SEE INTERIM DISPOSITION #4 - MK 8/17/93
SEE VMRR 006184 FOR DISPOSITION AUTHORITY. MK 8/20/93
SEE ATACHED INTERIM DISPOSITION # 5 TO CONTINUE PROCESSING.MGG 8/23/93

ITEM INFORMATION

ITEM:	OPER NO:	AFF QTY:	SERIAL NO:	DWG SPEC:	DEFECT CODE:	RESP ORGN:	OCC/REC:	DISP CODE:	DISP QTY
01	MAT0030	1	10705	SE2073 3.3.1.2	510 14	2110D	R	A	1
02	MAT0030	1	10705	SE2073 3.3.10	335 58	2110D	R	A	1
03	MAT0030	1	10705	SE20733.2.2	335 29	2110D	R	A	1
04	MAT0030	1	10705	12003 NOTE/47	125 12	2110D	R	O	1

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DISCREPANCY & DISPOSITION

ITEM: DISCREPANCY DESCRIPTION:

01 S/B:ALL SURFACE PREPARATIONS,ADHESIVE APPLICATIONS ACTIVITIE S SHALL BE PERFORMED IN A DESIGNATED BONDING ROOM.
IS:THE INSULATION WAS NOT BONDED INSIDE BONDING ROOM.

DISPOSITION DESCRIPTION:
USE-AS-IS. RISPN UNAFFECTED. THE ACCEPTABLE RESULTS OF THE TESTING AND INSPECTIONS PERFORMED IN ACCORDANCE WITH INTERIM DISPOSITIONS #1-4 SHOW THE INSULTOR-TO-CLOSURE BOND IS ACCEPTABLE. THE BOND TEST PANEL WHICH WAS CO-PROCESSED WITH THE DELTA QUALIFICATION AFT CLOSURES (CONT.)

02 S/B:VACUUM SHALL BE HELD ON CLOSURE INSULATORS FOR A MIN. OF 12HRS PRIOR TO BEGINNING OF CURE CYCLE.AFTER HOLD,THEPART MAY NOT BE WITHOUT VACUUM MORE THAN 2 HRS.ALL PARTS SHALL BE HELD UNDER A MINIMUM VACUUM OF 22 INCHES.
IS:CHART HAS ILLEGIBLE READINGS FOR APPROX.5HRS13MIN

EXHIBITED ACCEPTABLE RESULTS OF 89 PLI WHICH ARE FAR IN EXCESS OF THE MINIMUM REQUIREMENT OF 25 PLI. IN ADDITION, THE FAILURE MODE OF THE PANEL WAS COHESIVE IN THE RUBBER. THIS MEANS THE BOND STRENGTH IS GREATER THAN THE RUBBER STRENGTH WHICH SHOWS THE EXCELLENT QUALITY OF THE BOND. THE ULTRASONIC AND TAP INSPECTION SHOWED NO UNBONDS WHICH CONFIRMS THE BOND QUALITY. TOGETHER, THE ACCEPTABLE AND EXCELLENT RESULTS OF THE CO-PROCESSED PEEL PANEL, ULTRASONIC INSPECTION AND TAP INSPECTION SHOWS THAT THE BOND PROCESS NOT BEING PERFORMED IN A DESIGNATED BOND ROOM HAD NO EFFECT ON THE BOND QUALITY.
USE-AS-IS. RISPN UNAFFECTED. SEE ITEM 1 FOR RATIONALE.

03 S/B:NON SILICONE TAPES SHALL BE USED.

USE-AS-IS. RISPN UNAFFECTED. THE INNER AND OUTER INSULATOR

IS:TAPES USED ARE NOT CERTIFIED FOR SILICONE CONTENT.

04 S/B:ULTRASONIC INSECTION OF BONDING AREA.
IS:NDT INSPECTION OF INSULATOR BOND AREA WAS PERFORMED. NO UNBONDS NOTED IN AREAS INSPECTED.ONE AREA,FROM 210DEG TO 150DEG,WHERE NDT INSPECTION CANNOT BE PERFORM DO TO A CIRCUMFERENTIAL SURFACE RIDGE UP TO 0.1"WIDE,(SEE EXPANS) X 0.06 HIGH ON INSULATOR SURFACE.

BOND EDGES WERE INSPECTED IN ACCORDANCE WITH DRAWING REQUIREMENTS. THE BONDLINE CONDITION WAS ACCEPTABLE WITH NO CONDITIONS REQUIRING REWORK WITH ADHESIVE. THE INSULATOR EDGES ARE IMMEDIATELY ADJACENT TO THE AREAS THAT (-->) ARE MASKED WITH TAPE DURING PROCESSING. THE ACCEPTABLE EDGE BOND CONDITION DEMONSTRATES THAT THE USE OF NON-CERTIFIED TAPES DID NOT ADVERSELY AFFECT THE BOND. OTHER. RISPU UNAFFECTED. THE RAISED MATERIAL WAS REMOVED IN ACCORDANCE WITH INTERIN DISPOSITION #4 AND THE ULTRASONIC INSPECTION PERFORMED PER APPROVED REPAIR PLANNING. THE REMOVAL WAS ACCOMPLISHED SUCCESSFULLY WITH NO GOUGES OR DEPRESSIONS CREATED IN THE INSULATOR SURFACE. THE (CONT) ULTRASONIC INSPECTION WAS ACCEPTABLE WITH NO UNBONDS NOTED.

CAUSE & CORRECTIVE ACTION

ITEM:	CAUSE CODE:	CAUSE NARRATIVE:	CA CODE:	CORRECTIVE ACTION NARRATIVE:
01	40		40	SEE USBI CAR #659.
02	11	SEE USBI CAR #659. DURINGVACUUM HOLD, VACUUM CHART BECAME JAMNED FOR A PERDID OF TIME. NO OVEN WATCH WAS AVAILABLE.	11	VACUUM RECORDER WAS CLEANED AND PUT BACK INTO SERVICE. DATA BEFORE AND AFTER INDICATED THAT VACUUM WAS HELD. OVEN WATCH WILL BE SCHEDULED DURING AUTOCLAVE OPERATION TO VERIFY PRINTER IS RECORDING.
03	40		40	SEE USBI CAR #659.
04	11	SEE USBI CAR #659. THE RIDGE IN THE AFT CLOSURE INSULATION OF THE DELTA QUALIFICATION ASSEMBLIES WAS CAUSED BY AN EXCESSIVE AMOUNT OF BLEEDER CLOTH WHICH WAS PLACED IN THE VACUUM BAG OVER THE INSULATOR FORMING DONUT (REF.SK-MFP081993-1). AS CAN BE SEEN IN THE SKETCH, THE EXCESSIVE BLEEDER CLOTH WAS UNABLE TO PROPERLY PULL DOWN INTO THE CORNER WHICH LEFT A SPACE. THIS SPACE SUBSEQUENTLY FILLED WITH RUBBER UNDER HEAT AND PRESSURE OF THE AUTOCLAVE CURE WHICH FORMED A RIDGE IN THE INSULATION.	11	THE CORRECTIVE ACTION WILL BE TO CONTROL THE AMOUNT OF BLEEDER CLOTH INSTALLED IN THE VACUUM BAG. ONLY TWO LAYERS OF NYLON RELEASE CLOTH WILL BE USED OVER THE FORMING DONUT.THIS METHOD OF BAGGING IS SIMILAR TO THAT USED ON THE DEMOSTRATION UNITS. THE DEMOSTRATION UNITS WERE COMPLETELY ACCESSIBLE TO NDT INSPECTION IN THE AREA WHERE THE RIDGE FORMED ON THE DELTA QUALIFICATION UNITS. THIS CORRECTIVE ACTION WILL BE CONFIRMED BY THE FABRICATION OF ONE ADDITIONAL DEMOSTRATION UNIT. THE NOZZLE ASSEMBLY PRODUCTION PLANNING FOR LOT ABA WILL THEN BE REVISED TO CONTROL THE AMOUNT OF BLEEDER CLOTH INSTALLED AND A PICTORIAL DEPICTION OF THE PROPER BAG-GING TECHNIQUE WILL BE ADDED. TRAINING SESSIONS WILL BE CONDUCTED AND DOCUMENTED TO INSURE OPERATORS WHO PERFORM INSULATION VULCANIZATION PROCESSES ARE KNOW-LEDGEABLE REGARDING PLANNING AND PROCESS REQUIREMENTS. THE NOZZLE ASSEMBLY DRAWINGS WILL BE REVISED TO SPECIFY THE ALLOWED POST-VULCANIZATION CONTOUR OF THE INSULATOR.

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

NCR Disposition
Continuation Sheet

12 DISCREPANT ITEM NAME	13 DISCREPANT ITEM P/N	28 ORIGINATOR	DATE	4 REF NCR NO	5 PAGE
BSM Nozzle Qual 2	B12003-10-01	M. Payne	7/29/93	D11923	3 of 3

35 ITEM	36 QTY	37 DISP CODE	38 ITEM DISPOSITION	39 INITIALS	40 QUALITY
			INTERIM DISPOSITION #1		
			Continue processing of peel test panel		
			through testing in accordance with SE2073.		
			Report results to MRB.		

7/29/93
M. Payne CSD Design Engineer

Approved J. Lanier 7/29/93 CSD Mgr

USBI: [signature] 7/30/93

CONCURRED WITH By USBI/HSV ENGINEERING AND QUALITY ENGINEERING

DCMO CSD QA - Cliff J. Sherlock 7-30-92

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UNITED TECHNOLOGIES CHEMICAL SYSTEMS

NCR Disposition
Continuation Sheet

12 DISCREPANT ITEM BASE	13 DISCREPANT ITEM P/N	28 ORIGINATOR	DATE	4 NCR NUMBER	5 PAGE OF
BSM Nozzle Qual 2	B12003-10-01	J. M. Payne	7/31/93	D11923	4 1

35 ITEM | 36 QTY | 37 DISP CODE | 38 ITEM DISPOSITION | 39 MANHOURS | 40 QUALITY

INTERIM DISPOSITION #2

Based on acceptable results of interim disposition #1, cohesive rubber failure and 89 PLI peel strength, proceed to edge bond inspection and ultrasonic testing. Report results to MRB.

Isabel M. Payne 7/31/93
CSD Quality Engineering

Per CAROL DANIELS Telecon 11:10AM 7/31/93 CSD QE

USAF: Lawrence W. Lake 7/31/93

CONCURRED WITH PROPULSION/USAF ENGINEERING AND QUALITY ENGINEERING

DPRO: Kevin Calvez/Telecon @ 1340 7/31/93 per Nadine

SEE ATTACHED UT REPORT FOR RESULTS.

UNABLE TO COMPLETE INSPECTION BECAUSE OF RIDGE ON PART.

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UNITED TECHNOLOGIES CHEMICAL SYSTEMS

NCR Disposition
Continuation Sheet

12 DISCREPANT ITEM NAME	13 DISCREPANT ITEM P/N	28 ORIGINATOR	DATE	4 REF. ITEM NO.	5 PAGE
BSM NOZZLE QUAL	B12003-10-01	MARY DELANEY	8-3-93	D11923	5

35 ITEM	36 QTY	37 DISP CODE	38 ITEM DISPOSITION	39 OPERATIONS	40 SHALL/IT
4-4	1	0	INTERIM DISPOSITION #3		
			CONTINUE PROCESSING THROUGH PROCESS INSTRUCTION		
			07.2.048 REV C, OPERATION 11, STEP 050.		
			CSD ENG: Arden M. Edwards 8/4/93		
			CSD QUAL ENG: Carl Daniel 8/4/93		
			USBI: Paul Lundy 8/4/93		
			DCMO: Ray Carver 5 Aug 93		

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TAP TEST EXAMINATION DATA SHEET

PART NAME	PART NUMBER/DRAWING/REV	PLANNING DOCUMENT #
BSM NOZZLE ASSEMBLY	B12003-10-01/ B12003-10-01/	NCR D11923
WORK INSTRUCTION — TECH #	**ACCEPT/REJECT CRITERIA**	**HAMMER SIZE**
60.12.9-590-001	PER PLANNING	.50 OZ
TYPE OF MATERIAL	**NCR #**	**PROJECT NO/WO# **
RUBBER	NONE	5597/5597-986-0000

ITEM S/N	IDENTIFICATION DESCRIPTION/REMARKS	ACC
I0705	NO UNBONDS NOTED	*

SKETCH

* ACCEPTANCE DETERMINED BY CALCULATIONS AT DAR STEP D024.

INSPECTOR	LEVEL	DATE
Michael Perlin	II	7-31-93

Ultrasonic Report/ Calibration Sheet

Page 1 of 1

PART NAME: BSM NOZZLE ASSEMBLY	WORK ORDER NUMBER: 5597-986-0000
PART NUMBER: B12003-10 -01	PLANNING DOCUMENT INFO. Release No.: NCR# D11923 INTERIM #2
Material: RUBBER/ALUM	NCR No (If applicable): NONE
Specification/Technique: SE1754/60.12.9-553	Component Serial No.: I0705
	Project Name: BSM

Quantity			
Received	Inspected	Accepted	Rejected
1	1	*	*

Instrument/Serial Number: SONIC MK IV	Calibration Date: 9-16-93
Transducer — Size/Frequency: .25"/10 MHZ/	Serial Number:
Scanning Method: CONTACT	
Test Blocks/Standards: STANDARD# K371	
COUPLANT: ULTRAGEL II	

CALIBRATION CHECKS

Initial: Time: 1430

Intermediate: Time: —

Final: Time: 1530

INSTRUMENT SETTINGS

Sweep C: _____ F: _____

Delay C: PER W.I. F: _____

dB: _____ Reject On Off

Frequency: _____

EXAMINATION AREA	COMMENTS
100%	*ACCEPTANCE DETERMINED BY CALCULATIONS AT DAR STEP D024.
	UNABLE TO INSPECT PART FROM 210° TO 150° .10" WIDE BECAUSE OF RIDGE ON PART.
	NO UNBONDS NOTED

Michael Peele (47 CS) — Inspector

II — Level

7-31-93 — Date

CSD 2795 (92/03)

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

NCR Disposition
Continuation Sheet

12 DISCREPANT ITEM NAME	13 DISCREPANCY REPORT NUMBER	28 ORIGINATOR	DATE	4 REV./MOD NO	5 PAGE OF
BSM Nozzle Qual 2	B12003-10-01	Garland M. Payne	8/17/93	D11923	8 1

35 ITEM	36 QTY	37 DISP CODE	38 DISPOSITION	39	40 QUALITY
			Interim Disposition #4		
4	1		Continue processing by removing the raised material by abrasion until the 0.1 inch wide area is flush with the adjacent surfaces. The abraded area must be smooth and continuous. CSD Engineering and USBI shall witness the abrasion operation. Photographs shall be taken of the raised area prior to and after abrasion. The abraded area is then to be inspected to the dwg. requirements for ultrasonic and typ inspection. Report results to MRB.		
			Garland M. Payne 8/17/93 CSD Design Engineer		
			Mike Kinkade CSD QUALITY 8/17/93		
			USBI: [signature] 8-18-93		

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Pg. 18 of 28
Vendor 1036434
Engineering

NON-CONFORMANCE
REWORK/REPAIR PLANNING

Work Order Number: 5597-986-0005		Release No.: MFGA96733
Part No.: B12003-10-01	NCR No.: D11923	Approvals: M.E. 8/13/93 Q.E. 8/13/93 USBI 8-17-93 GOVT 8-17-93

MA-54 No Safety Lead

Page 1 of 2

OPERATION	WORK CTR.	OPERATIONS INSTRUCTIONS	OPS	Q.C.	CUST.
			STP-DT	STP-DT	STP-DT

SCOPE

THIS PLANNING PROVIDES DETAILED INSTRUCTIONS TO REMOVE THE RIDGE ON THE BSM CLOSURE INSULATION. S/N 10705 NCR ITEM # 4.

CAUTION

DURING USE OF THE MOTO-TOOL TAKE CARE NOT TO MARK INSULATOR WITH MOTO-TOOL CHUCK,ANY MARKS MADE WITH CHUCK MAY BE CLEANED UP WITH 80 GRIT SAND PAPER.

CAUTION

WORK SHALL BE PERFORMED IN A WELL LIT AREA.

0010 P0020P04

REMOVE RIDGE FROM CLOSURE INSULATION SURFACE UNTIL IT IS FLUSH WITH SURROUNDING SURFACE USING MOTO-TOOL MODEL # YA 3950B WITH ALUMINUM OXIDE TIP P/N5000952, SET AT SPEED 5. DURING REMOVAL PROCESS NDT INSPECTOR SHALL INSPECT SURFACE PERIODICALLY TO ASSIST IN REMOVING THE MINIMAL AMOUNT OF MATERIAL SO NDT CAN BE PERFORMED. FINAL CLEAN UP OF AREA AND ANY MARKS MADE FROM THE CHUCK SHALL BE DONE WITH 80 GRIT SANDPAPER(P/N CSD 35030)AND A SANDING BLOCK.. USBI AND GOVT WITNESS. GOVT VERIFY.

P 21 8-18-93 | 160 8/18/93 | 680 8-18-93 USBI

QE 56 8/18/93 | P301 CSD 8-18-93 | P301 CSD 8-18-93

GOVT 8-17-93

WARNING

ISOPROPYL ALCOHOL IS FLAMMABLE. IT IS TOXIC BY INGESTION OR INHALATION. IT IS ALSO A SKIN AND EYE IRRITANT. ADBQUATE DILUTION VENTILATION IS REQUIRED. IN LIEU OF ADBQUATE VENTILATION, A RESPIRATOR WITH ORGANIC VAPOR FILTER CARTRIDGES IS RBQUIRED. LATEX RUBBER, NEOPRENE, OR NITRILE GLOVES AND GOGGLES ARE ALSO REQUIRED.

OFFICIAL COPY

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PA = 10.

NON-CONFORMANCE
REWORK/REPAIR PLANNING

Work Order Number: 5597-986-0005		Release No.: MFGA96733	Page 2 of 2	
Part No.: B12003-10-01	NCR No.: D11923			
		OPS STP-DT	Q.C. STP-DT	CUST. STP-DT

OPERATION	WORK CTR.	OPERATIONS INSTRUCTIONS
0020	P0020P04	CLEAN SURFACE WITH A RYMPLE CLOTH DAMPENED WITH ISOPROPYL ALCOHOL. ALLOW TO AIR DRY 20 MINUTES MINIMUM.
0030	P0020P04	Q.C. VISUALLY INSPECT INSULATION REPAIR AREA. NO GOUGES OR DEPRESSIONS ALLOWED. USBI AND GOV'T INSPECT.
0040	Q1319Q99	NDT PERFORM ULTRASONIC INSPECTION PER WORK INSTRUCTION 60.12.9-590 AND 60.12.9-553. MAP ON STANDARD (ORIGINAL) PLANNING DAR STEPS AND MAT OPERATIONS.
0050	Q1319Q99	PERFORM UNBOND CALCULATION PER WORK INSTRUCTION 60.12.9-251 RECORD ON STANDARD (ORIGINAL) PLANNING DAR STEPS AND MAT OPERATIONS. USBI WITNESS.
0060	QXXXXP99	Q.C. REVIEW NCR PLANNING FOR COMPLETENESS. GOV'T REVIEW .

P 303 C S 8-19-93

258 P50 8/19/93 USBI 8/19/93

41 (S) 8-19-93

160 C50 8-19-93 USBI 8/19/93

258 P50 8/19/93 GOV'T 8-19-93

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VMRR 006184
Attachment II

Ultrasonic Report/ Calibration Sheet

Page 1 of 1

PART NAME: BSM NOZZLE ASSY	WORK ORDER NUMBER: 5597-986 0000
PART NUMBER: B12003-1D-01	PLANNING DOCUMENT INFO Release No.: NCR 011923 / NCR No. (If applicable): NONE
Material: RUBBER	Component Serial No.: IO 705 / Project Name: BSM
Specification/technique: SE 1754 / 60.129-553	CALIBRATION CHECKS Time — Initial: 1100
Quantity: Received 1 / Inspected 1 / Accepted 1 / Rejected Ø	Time — Intermediate:
	Time — Final: 1120
Instrument/Serial Number: SONIC MK II / Calibration Date: 9-16-93	INSTRUMENT SETTINGS
Transducer — Size/Frequency — Serial Number: .25/10MHz / 92266452	Sweep C: ____ F: ____
Scanning Method: CONTACT	Delay C: REG F: ____
Test Blocks/Standards: K 371	dB: A2 Reject On Off
COUPLANT: ULTRAGEL II	Frequency: ____

EXAMINATION AREA	COMMENTS
100% of SANDED AREA	

Inspector: [signature] Level: II Date: 8-19-93

CSD 2795 (92/03)

TAP TEST EXAMINATION DATA SHEET

PART NAME	PART NUMBER/DRAWING/REV	PLANNING DOCUMENT #
BSM NOZZLE ASSY	B1200 3-10-01	NCR D11
WORK INSTRUCTION — TECH #	**ACCEPT/REJECT CRITERIA**	**HAMMER SIZE**
60.12.9 SED-001	PER NCR	1½ oz
TYPE OF MATERIAL	**NCR #**	**PROJECT NO/WOR #**
RUBBER	NONE	5597-986-0005

ITEM S/N	IDENTIFICATION DESCRIPTION/REMARKS	ACC
I0705	NO UNBONDS NOTED ON SANDED AREA	*

SKETCH

ACCEPTANCE DETERMENED BY CALCULATIONS AT DAR STEP D024

160

INSPECTOR	LEVEL	DATE
	II	6-19-93

NCR: D08262 PLANT: COY DISC CAT: RI REF NO: N/A PR/MRB: MRB WC/OB: REPORT DATE: 07/26/93 PAGE: 1

DISC P/N: SE0754
DISC P/NAME: HX-752
MFG PART NO: N/A
MFG PART NM: N/A
MFG SER NO: LOT 50
PLAN REL: QC0007965
PROJECT NO: 5592
BUILDING: 1210
WORK AREA: QLR

UOM: LB
LOT SIZE: 72
REJECT NO: 72
CAR/FRR:

NCR DATE: 04/02/92
DISPOSITION DATE: 04/07/92
CLOSE DATE: 04/23/92
DPRO COMMENTS: NO

PO:
VENDOR NO: PZ0407347
VEND NAME: 013362
VEND DOC NO: THREE M CO./IND. CH N/A

INSPECTOR	N/A	
VALIDATION	AMANDA RAMIREZ	04/02/92
DISPOSITION	JOSEPH HENRY	04/02/92
CAUSE/CA (UTC)	N/A	04/07/92
CAUSE/CA (VEN)	CAROL DANIELS	
QUAL DES ENGR	CAROL DANIELS	04/09/92
CUSTOMER	DWAYNE W. WILSON	04/09/92
CUSTOMER		04/11/92
GOVT REP	CLIFF SHERLOCK	
MFG ENG REWORK	N/A	04/16/92
PURCH BUYER	N/A	04/16/92
INSP ACCEPT	MYRNA LEFTWICH	04/16/92
		04/23/92

NCR NARRATIVE

TWO COMPOSITE SAMPLES WERE TESTED FOR LOT ACCEPTANCE. THE INFRARED SCAN DOES MATCH THE QC LAB'S INTERNAL REFERENCE. SEE NCRS D07544, D07057 AND CAR D07057. CD 4/9/92

ITEM INFORMATION

ITEM:	OPER NO:	AFF QTY:	SERIAL NO:	DWG SPEC:	DEFECT CODE:	RESP ORGN:	OCC/REC:	DISP CODE:	DISP QTY
01	N/A	72	LOT 50	SE0754D 3.3	695 58	QACA	R	A	72

DISCREPANCY & DISPOSITION

ITEM: 01

DISCREPANCY DESCRIPTION:
THE PEAKS ON THE INFRARED SPECTRUM SHALL BE WITHIN (+/-) 5 MICRONS OF THE CORRESPONDING PEAKS OF THE REFERENCE SPECTRUM -THERE ARE PEAKS (@8&13.5 MICRONS) ON THE SAMPLES SPECTRUM OF WHICH THERE ARE NO CORRESPONDING PEAKS ON THE SPECIFICATION'S REFERENCE SPECTRUM.

DISPOSITION DESCRIPTION:
USE AS IS. RISPW UNAFFECTED. IR SCAN MATCHES QC LAB REFERENCE SCAN WHICH WAS GENERATED WITH MORE MODERN EQUIPMENT THAN THE SPECIFICATION SCAN. THE LOT 50 AND QC LAB SCANS SHOW BANDS IN THE REGION OF 1250 TO 1190 1/CM (8-8.4 MICRONS) AND 800 - 667 1/CM (12.9 - 15 MICRONS) WHICH DO NOT -CONT. APPEAR IN THE SPECIFICATION SCAN. THESE REGIONS CORRESPOND TO THE ABSORPTION BANDS OF CHLOROFORM, THE IR CARRIER SOLVENT. THUS LOT 50 IR SCAN DOES NOT REVEAL ANY CONTAMINATION. A CHANGE REQUEST IS BEING PREPARED TO UPDATE THE SPECIFICATION REFERENCE SCAN.

CAUSE & CORRECTIVE ACTION

ITEM:	CAUSE CODE:	CAUSE NARRATIVE:
01	40	SEE CAR D07057

CA CODE:	CORRECTIVE ACTION NARRATIVE:
40	SEE CAR D07057

NCR: D08388 PLANT: VEN DISC CAT: RI REF NO: N/A PR/MRB: MRB WC/OB: REPORT DATE: 07/26/93 PAGE: 1

DISC P/N: SE0724
DISC P/NAME: ANTIOXIDANT 2246 (A02246)
MFG PART NO: N/A
MFG PART NM: N/A
MFG SER NO: LOT 20
PLAN REL: 0007989
PROJECT NO: 5594
BUILDING: 1210
WORK AREA: QLR

UOM: LB
LOT SIZE: 50
REJECT NO: 50
CAR/FRR:

NCR DATE: 04/14/92
DISPOSITION DATE: 04/21/92
CLOSE DATE: 06/01/92
DPRO COMMENTS: YES

PO: PZ0407343
VENDOR NO: 001981
VEND NAME: AMERICAN CYANAMID
VEND DOC NO: N/A

INSPECTOR	N/A	
VALIDATION	RUSSELL GIBSON	04/14/92
DISPOSITION	RAYMA RODRIGUEZ	04/14/92
CAUSE/CA (UTC)	N/A	04/21/92
CAUSE/CA (VEN)	CAROL DANIELS	
QUAL DES ENGR	CAROL DANIELS	05/12/92
CUSTOMER	DWAYNE W. WILSON	05/12/92
CUSTOMER		05/22/92
GOVT REP	RAYMOND CORREA	
MFG ENG REWORK	N/A	05/27/92
PURCH BUYER	N/A	05/27/92
INSP ACCEPT	MYRNA LEFTWICH	05/27/92
		06/01/92

NCR NARRATIVE

MATERIAL PURCHASED THROUGH DISTRIBUTOR WILLIAM F. MCDONALD VENDOR NO. 17214
NOTE: INFRARED SPECTRUM DOES MATCH Q.C. LAB'S INTERNAL REFERENCE.

ITEM INFORMATION

ITEM:	OPER NO:	AFF QTY:	SERIAL NO:	DWG SPEC:	DEFECT CODE:	RESP ORGN:	OCC/REC:	DISP CODE:	DISP QTY
01	N/A	50	LOT 20	SE0724 3.3	695 58	QACA	0	A	50

DISCREPANCY & DISPOSITION

ITEM: 01

DISCREPANCY DESCRIPTION:
THE PEAKS ON THE INFRARED SPECTRUM SHALL BE WITHIN +/- 5 MICRONS OF THE CORRESPONDING PEAKS OF THE REFERENCE SPECTRUM. THERE ARE PEAKS (@ 8 & 13.5 MICRONS) ON THE SAMPLES SPECTRUM OF WHICH THERE ARE NO CORRESPONDING PEAKS ON THE REFERENCE SPECTRUM.

DISPOSITION DESCRIPTION:
USE AS IS. RISPW UNAFFECTED. IR SCAN MATCHES THE QC LAB REFERENCE SCAN WHICH WAS GENERATED WITH MORE MODERN EQUIPMENT THAN THE SPECIFICATION SCAN. THE 8 AND 13.5 MICRON CORRESPOUND TO THE ABSORPTION PEAKS OF THE CHLOROFORM CARRIER. A CHANGE REQUEST IS BEING PREPARED TO UPDATE (CONT'ED) THE SPECIFICATION IR REFERENCE SCAN.

CAUSE & CORRECTIVE ACTION

ITEM:	CAUSE CODE:	CAUSE NARRATIVE:	CA CODE:	CORRECTIVE ACTION NARRATIVE:
01	40	SEE CAR D8388.	40	SEE CAR D8388.

DISC P/N: B12018-14-01
DISC P/NAME: CORR,INSP.CLOSURE
MFG PART NO: N/A
MFG PART NM: N/A
MFG SER NO: MULTI
PLAN REL: MULTI
PROJECT NO: 5592
BUILDING: 0020
WORK AREA: PBS

UOM: EA
LOT SIZE: 8
REJECT NO: 8
CAR/FRR:

NCR DATE: 11/02/92
DISPOSITION DATE: 11/19/92
CLOSE DATE: 12/01/92
DPRO COMMENTS: NO

PO: N/A
VENDOR NO: 000000
VEND NAME:
VEND DOC NO: N/A

INSPECTOR	MARK RADOVIC	11/17/92
VALIDATION	CAROL DANIELS	11/17/92
DISPOSITION	LARRY MURPHY	11/19/92
CAUSE/CA (UTC)	N/A	
CAUSE/CA (VEN)	CAROL DANIELS	11/17/92
QUAL DES ENGR	CAROL DANIELS	11/20/92
CUSTOMER	DWAYNE W. WILSON	11/25/92
CUSTOMER		
GOVT REP	RAYMOND CORREA	11/25/92
MFG ENG REWORK	N/A	11/25/92
PURCH BUYER	N/A	11/25/92
INSP ACCEPT	MARK RADOVIC	12/01/92

NCR NARRATIVE

MFGA14009 S/N 10605,10705,10611,10671,10644,10716,10629,10680.

ITEM INFORMATION

ITEM:	OPER NO:	AFF QTY:	SERIAL NO:	DWG SPEC:	DEFECT CODE:	RESP ORGN:	OCC/REC:	DISP CODE:	DISP QTY
01	0040	8	MULTI	B12006 F/5	245 58	QACA	0	A	8

DISCREPANCY & DISPOSITION

ITEM: DISCREPANCY DESCRIPTION:
01 S/B: THREAD PITCH DIA. 11.7793"/11.7917".
IS: RANGES FROM 11.770 MIN. TO 11.776 MAX.

DISPOSITION DESCRIPTION:
USE-AS-IS. RISPW UNAFFECTED. STRUCTURAL ANALYSIS SFK-12-88-E FOR A 11.7722 INCH PITCH DIAMETER CONCLUDED THAT A +0.11 MARGIN-OF-SAFETY EXISTED FOR ALL CLOSURES WITH PITCH DIAMETERS GREATER THAN OR EQUAL TO THIS VALUE. FOR A CLOSURE WITH A 11.7692 INCH PITCH DIAMETER (REF. NCR D07308), THE ANALYSIS WAS REVISED FOR THE SMALLER DIAMETER AND CONCLUDED THAT +0.099 MARGIN-OF-SAFETY EXISTED. THEREFORE, SINCE ALL OF THE EIGHT CLOSURES ON THIS NCR HAVE PITCH DIAMETERS GREATER THE 11.7692 VALUE, ALL WILL HAVE A MARGIN-OF-SAFETY GREATER THAN +0.099. THE FUNCTION OF THESE CLOSURES WILL NOT BE AFFECTED BY THE SMALLER PITCH DIAMETERS ON THE BUTTRESS THREADS AND ALL ARE ACCEPTABLE FOR FLIGHT USE.

CAUSE & CORRECTIVE ACTION

ITEM:	CAUSE CODE:	CAUSE NARRATIVE:	CA CODE:	CORRECTIVE ACTION NARRATIVE:
01	13	CLOSURES WERE MADE BY AN OUTSIDE SOURCE AND THEIR METHODS AND PROCEDURES WERE NOT ADEQUATE FOR MEETING DWG REQUIREMENTS/TOLERANCES. THIS IS THE SAME PROBLEM AS ON NCR D8012.	13	CURRENT PRODUCTION ORDER HAS BEEN FILLED. VENDOR PLANNING WILL BE REVIEWED AND APPROVED BY CSD PRIOR TO START OF ANY NEW PRODUCTION. THE REMAINING CLOSURES IN STOCK ARE BEING DIMENSIONALLY CHECKED PRIOR TO USE.

NCR: D12186 PLANT: COY DISC CAT: MT REF NO: PR/MRB: MRB WC/OB: REPORT DATE: 09/03/93 PAGE: 1

DISC P/N: B12003-10-01
DISC P/NAME: BSM NOZZLE ASSY AFT Q2
MFG PART NO: B12000-14-01
MFG PART NM: BSM MOTOR ASSY - Q2
MFG SER NO: I0705
PLAN REL: MFGA96733
PROJECT NO: 5597
BUILDING: 0485
WORK AREA: PBS

UOM: EA
LOT SIZE: 1
REJECT NO: 1
CAR/FRR:

NCR DATE: 09/02/93
DISPOSITION DATE: 09/03/93
CLOSE DATE: 09/03/93
DPRO COMMENTS: NO

PO:
VENDOR NO: 000000
VEND NAME:
VEND DOC NO:

INSPECTOR	N/A	
VALIDATION	MIKE KISKILA	09/03/93
DISPOSITION	FREDERICK PAYNE	09/03/93
CAUSE/CA (UTC)	N/A	09/03/93
CAUSE/CA (VEN)	MIKE KISKILA	
QUAL DES ENGR	MIKE KISKILA	09/03/93
CUSTOMER	DWAYNE W. WILSON	09/03/93
CUSTOMER		09/03/93
GOVT REP	RAYMOND CORREA	
MFG ENG REWORK	N/A	09/03/93
PURCH BUYER	N/A	09/03/93
INSP ACCEPT	ROBERT LOPEZ	09/03/93
		09/03/93

NCR NARRATIVE

MOTOR 1000734. DISCREPANCY FOUND ON REVIEW OF BUILD PAPER.

ITEM INFORMATION

ITEM:	OPER NO:	AFF QTY:	SERIAL NO:	DWG SPEC:	DEFECT CODE:	RESP ORGN:	OCC/REC:	DISP CODE:	DISP QTY
01	PD016	1	I0705	SE2017 PARA 3.3.12.3	335 58	QACA	001	A	1

DISCREPANCY & DISPOSITION

ITEM: 01

DISCREPANCY DESCRIPTION:
S/B: TOP COAT PAINT APPLICATION TO BE BETWEEN 4 HOURS AND 8 HOURS OF PRIMER APPLICATION.
IS: TOP COAT PAINT APPLICATION APPLIED AT 3 HOURS 50 MINUTES AFTER PRIMER APPLICATION.

DISPOSITION DESCRIPTION:
USE-AS-IS. RISPW UNAFFECTED. THE FOUR HOUR TIME PERIOD IS A MANUFACTURER RECOMMENDED TIME TO ALLOW ENOUGH PRIMER CURE TIME TO PREVENT SAGS OR RUNS IN THE TOPCOAT PAINT. THERE IS CONSERVATISM BUILT INTO THIS NUMBER SINCE THE PRIMER SETS UP TO A STIFF SURFACE IN THE FIRST TWO HOURS. (CONT.) THE APPLICATION OF THE TOPCOAT PAINT 10 MINUTES EARLY HAS NO IMPACT ON ITS ABILITY TO BOND TO THE PRIMER SURFACE AND DID NOT CAUSE ANY RUNS OR SAGS. THE WET TAPE TEST ON A WITNESS PANEL WAS SUCCESFUL VALIDATING THE PAINT/PRIMER/ALODINE/CASE SYSTEM INTEGRITY.

CAUSE & CORRECTIVE ACTION

ITEM:	CAUSE CODE:	CAUSE NARRATIVE:	CA CODE:	CORRECTIVE ACTION NARRATIVE:
01	12	MULTIPLE REQUIREMENTS OF THE SPEC WERE NOT CLEARLY INTERPRETED IN THE PLANNING/DAR LEADING TO OPERATOR CONFUSION.	12	DAR AND PROCESS INSTRUCTION WILL BE CLARIFIED, (REFERENCE PCS 042945). OPERATOR WAS RE-INSTRUCTED ON ALL REQUIREMENTS OF THIS PROCESS.

NCR: D12394 PLANT: COY DISC CAT: MT REF NO: N/A PR/MRB: MRB WC/OB: REPORT DATE: 01/06/94 PAGE: 1

DISC P/N: B12000-14-01-501
DISC P/NAME: BSM DELTA QUAL MTR.TST.AF
MFG PART NO: N/A
MFG PART NM: N/A
MFG SER NO: N/A
PLAN REL: MFGA 96534
PROJECT NO: 5597
BUILDING: 0485
WORK AREA: PBS

UOM: EA
LOT SIZE: 1
REJECT NO: 1
CAR/FRR:

NCR DATE: 10/11/93
DISPOSITION DATE: 10/19/93
CLOSE DATE: 10/22/93
DPRO COMMENTS: NO

PO: N/A
VENDOR NO: 000000
VEND NAME:
VEND DOC NO: N/A

INSPECTOR	MARK RADOVIC	10/15/93
VALIDATION	MIKE KISKILA	10/15/93
DISPOSITION	LARRY MURPHY	10/19/93
CAUSE/CA (UTC)	N/A	
CAUSE/CA (VEN)	MIKE KISKILA	10/19/93
QUAL DES ENGR	MIKE KISKILA	10/19/93
CUSTOMER	PAUL LUNDY	10/19/93
CUSTOMER		
GOVT REP	CLIFF SHERLOCK	10/19/93
MFG ENG REWORK	BECKY TIMEWELL	10/22/93
INSP ACCEPT	MARK RADOVIC	10/22/93

NCR NARRATIVE

ITEM INFORMATION

ITEM:	OPER NO:	AFF QTY:	SERIAL NO:	DWG SPEC:	DEFECT CODE:	RESP ORGN:	OCC/REC:	DISP CODE:	DISP QTY
01	PD003	1	1000734	B12001-02-01 4/H DN3	250 70	VEND	N	RP	1
02	PD003	1	1000734	B12001-02-01 4/H DN3	350 34	VEND	D01	A	1
03	PD003	1	1000734	CSD5597-93-1 REV.B	640 58	VEND	001	A	1
04	D014	1	1000734	B12018-13-01 8/E	245 58	VEND	N	A	1
05	D014	1	1000734	B12003-05/06-01	245 58	VEND	N	A	1

DISCREPANCY & DISPOSITION

ITEM: DISCREPANCY DESCRIPTION:

01 S/B:SURFACES INDICATED SHALL BE FREE OF TOOL MARKS,TOOL CHAT TER MARKS,NICKS,PITS,SCRATCHES,OR COROSSION.
IS:10 EACH OF THE 24 0.453"-0.457"DIA. HOLES ON THE AFT END EXHIBIT WASHER SCRATCHES ON THE I.D. WITH A WORST CASE OF APPROX. 0.4"L.X 0.01"R.

02 S/B:SAME AS ITEM #1.
IS:THE FWD. MOST OUTSIDE DIA. AND EDGE EXHIBITS A DENT 0.45" L.X 0.01"D.X 0.003" RAISED ON FWD.FACE @ 315 DEG.FLACCW

03 S/B:THE"COLD" MOTOR SHALL BE CONDITIONED AT 25 DEG. F. +0, -5 DEG.F. DURING ENVIRONMENTAL TESTING.
IS:DURING CONDITIONING THE TEMPERATURE EXCEEDED 25 DEG. ON THREE OCCASIONS STARTING ON 9/25/93 @ 1138 HRS FOR 8 MINUTES @ 1158HRS.FOR 2 MINUTES,& @ 1204 HRS. FOR 2 MINUTES.(CONT.) THE MAXIMUM TEMP. ENCOUNTERED DURING ANY ONE OF THE EXCUR- SIONS WAS 28.2 DEG. F.

04 S/B:0.3125-24 UNJF
IS:THE FOLLOWING HOLES ON THE FWD.FACE ACCEPT THE NO-GO

DISPOSITION DESCRIPTION:

REPAIR. RISPW UNAFFECTED. REPAIR BY CLEANING THE MARKED AREAS WITH SCOTCHBRITE AND COAT WITH ALODINE PER STANDARD PLANNING. RATIONALE: THE BOLT WASHER SCRATCH MARKS ARE IN A VERY LOW STRESS, NON-PRESSURIZED AREA OF THE MOTOR CASE (AFT SKIRT). THE WASHER SCRATCHES WILL NOT AFFECT THE HOLDING CAPABILITY OF THE STATIC TEST STAND MOUNTING FIXTURE BOLTS AND WASHERS AND THE MOTOR CASE AFT SKIRT. (CONT.)
USE-AS-IS. RISPW UNAFFECTED. THIS IS A NON-FUNCTIONAL SUR- FACE AND IS IN A LOW STRESS REGION THAT WILL BE UNAFFECTED WHEN THE MOTOR CASE IS PRESSURIZED. THIS AREA OF THE MOTOR CASE IS THE THICKEST PART OF THE CASE. THERE IS NO CONTACT OF ANY TOOLING ON THIS AREA DURING TEST STAND INSTALLATION.
USE-AS-IS. RISPW UNAFFECTED. DURING TEMPERATURE CONDITION- ING AND ENVIRONMENTAL VIBRATION TESTING AT TEMPERATURE, EX- CURSIONS OF TEMPERATURE OF LESS THAN 30 MINUTES DO NOT RE- QUIRE ADDITIONAL CONDITIONING. THE PROPELLANT MEAN BULK TEM PERATURE WILL NOT CHANGE DURING THESE SHORT TIMES WHEN (-->) THE TEMPERATURE IN THE CONDITONING BOX EXCEEDS THE LIMITS. THESE TEMPERATURE EXCURSIONS WERE NOTED DURING THE ACTUAL TESTING AND IT WAS THE DECISION OF THE CSD DESIGN ENGINEER- ING REP., USBI DESIGN ENGINEERING REP. AND NASA ENGINEERING THAT THE PROPELLANT TEMPERATURE WOULD NOT CHANGE SINCE THE CHANGE IN DRIVING TEMPERATURE AND TIME WERE SO SMALL. THE TESTING WAS THEN CONTINUED TO COMPLETION.
USE-AS-IS. RISPW UNAFFECTED. THE THREADED ATTACHMENT HOLES WERE TORQUED TO 155 IN-LB DURING THE ENVIRONMENTAL TESTING

05 ELEMENT ON THE THREAD GAGE WITH ORIENTATION BEING FLACCW HOLE #1 @ TDC:HOLE #1,#5,#6,#7,& #8.
S/B:8-32 UNC-3B THRU 12 PLACES AS SHOWN.
IS:ALL OF THE NOZZLE HOLES ACCEPT THE NO-GO ELEMENT.

AND FUNCTIONED ACCEPTABLY. SINCE THERE WAS NO MOVEMENT, THE INSERTS WILL FUNCTION ACCEPTABLY DURING STATIC FIRING. USE-AS-IS. RISPW UNAFFECTED. THESE THREADED ATTACHMENT HOLES WILL BE NON-FUNCTIONAL DURING A STATIC FIRING TEST W/O ANY HARDWARE REQUIRED THAT WOULD USE THESE HOLES. STRUCTURAL INTEGRITY OF THE NOZZLE EXIT CONE WILL BE UNAFFECTED.

CAUSE & CORRECTIVE ACTION

ITEM:	CAUSE CODE:	CAUSE NARRATIVE:	CA CODE:	CORRECTIVE ACTION NARRATIVE:
01	37	WASHER MARKS WERE CAUSED BY ATTACHMENT OF TEST TOOLING TO MOTOR.	30	NO CORRECTIVE ACTION REQUIRED. THIS AMOUNT OF MARKING BY THE WASHERS DURING THIS ACTIVITY IS CONSIDERED NORMAL AND UNAVOIDABLE.
02	13	DISCREPANCIES OCCURRED DUE TO HANDLING DAMAGE FROM TOOLING, FIXTURE INSTALLATION AND MOTOR MOVES DURING THE ENVIRONMENTAL TESTING AT THE TEST VENDOR.	13	ANY FUTURE TEST VENDORS FOR ENVIRONMENTAL TESTING WILL BE DIRECTED BY P.O. REQUIREMENT TO ASSURE TOOLING FIXTURES WILL BE HANDLED AND INSTALLED TO PREVENT DAMAGE TO CASE WALL, FWD DOME AND MOUNTING HOLES.
03	11	COLD TEMPERATURE EXCURSION WAS CAUSED BY POOR FIT OF CONDITIONING BOX TO VIBRATION TABLE DURING TESTING.	11	THE NEXT TEST WAS FIXED BY ADDING INSULATION TO THE CONDITIONING BOX TO IMPROVE THE FIT AND ELIMINATE LOSS OF CONDITIONED AIR.
04	37	HOLE ENLARGEMENT OCCURRED AS A RESULT OF FUNCTIONAL TESTING.	30	NO CORRECTIVE ACTION REQUIRED. THERE IS NO REQUIREMENT FOR HOLE SIZE COMPLIANCE AFTER FUNCTIONAL TESTING.
05	37	DISCREPANCY OCCURRED BECAUSE THREAD TAPS WERE USED TO REMOVE PROTECTIVE PRIMER FROM ATTACH HOLES.IT IS UN KNOWN IF A CORRECT, NEW TAP WAS USED OR HOW MANY TIMES THE TAP WAS RUN THROUGH THE HOLES.	30	NONE REQUIRED. THE TESTING IS COMPLETE. THIS IS A NON FUNCTIONAL ATTACHMENT AREA FOR THE DELTA QUAL MOTORS.

NCR: D14417 PLANT: COY DISC CAT: MT REF NO: PR/MRB: MRB WC/OB: REPORT DATE: 11/11/94 PAGE: 1

DISC P/N: B12000-14-01-501
DISC P/NAME: BSM DELTA QUAL TEST, AFT
MFG PART NO: B12003-10-01
MFG PART NM: NOZZLE ASSEMBLY
MFG SER NO: I0705
PLAN REL: MFGA96534
PROJECT NO: 5597
BUILDING: 485
WORK AREA: PBS

UOM: EA
LOT SIZE: 1
REJECT NO: 1
CAR/FRR:

NCR DATE: 09/06/94
DISPOSITION DATE: 10/27/94
CLOSE DATE: 11/11/94
DPRO COMMENTS: YES

PO:
VENDOR NO: 000000
VEND NAME:
VEND DOC NO:

INSPECTOR	N/A	
VALIDATION	MIKE KISKILA	09/09/94
DISPOSITION	LARRY MURPHY	09/09/94
CAUSE/CA (UTC)	N/A	10/27/94
CAUSE/CA (VEN)	MIKE KISKILA	
QUAL DES ENGR	MIKE KISKILA	10/27/94
CUSTOMER	PAUL LUNDY	11/03/94
CUSTOMER		11/03/94
GOVT REP	CLIFF SHERLOCK	
MFG ENG REWORK	N/A	11/04/94
PURCH BUYER	N/A	11/04/94
INSP ACCEPT	ADRIAN RANDLES	11/04/94
		11/11/94

NCR NARRATIVE

NOTE: MFG ITEM PN WAS IN ERROR ON NCR, WAS B12003-09-01, S/B B12003-10-01. CORRECTED. MK 11/10/94

ITEM INFORMATION

ITEM:	OPER NO:	AFF QTY:	SERIAL NO:	DWG SPEC:	DEFECT CODE:	RESP ORGN:	OCC/REC:	SIG:	DISP CODE:	DISP QTY:
01	N/A	1	1M734	CSD-5597-93-1 REV B	005 58	QACA	N		A	1

DISCREPANCY & DISPOSITION

ITEM: 01

DISCREPANCY DESCRIPTION:
S/B: DESIGN CHANGE SUCCESS CRITERIA SPECIFIES 90 MIL MAXIMUM EROSION DURING STATIC TEST.
IS: MEASURED EROSION OF 175 MILS.

DISPOSITION DESCRIPTION:
USE-AS-IS. RISPW UNAFFECTED. THE INSULATOR EROSION EXCEEDED THE 90 MIL REQUIREMENT AT THE INNER DIAMETER WHERE THE INSULATOR WRAPS OVER THE EDGE OF THE ALUMINUM CLOSURE. THE MAXIMUM EROSION OCCURRED AT 0 DEGREES (ALF) AT THE POINT OF MAXIMUM CLOSURE SUBMERGENCE. THE TEST RESULTS ARE ACCEPTABLE. ALTHOUGH THE SUCCESS CRITERIA OF 90 MIL. MAX. EROSION AS DEFINED IN THE QUALIFICATION TEST PLAN WAS NOT MET, VISUAL INSPECTION SHOWED THE INSULATORS REMAINED BONDED AND FULLY ATTACHED FOR THE FULL 360 DEGREE CIRCUMFERENCE AND NO AREAS OF ABNORMAL ABLATION WERE FOUND AS COMPARED TO THE SECONDARILY BONDED INSULATOR CONFIGURATION. VIRGIN RUBBER REMAINED AT ALL LOCATIONS ON THE CLOSURE. BASED UPON POST-TEST MEASUREMENTS, A CONSERVATIVE CALCULATION OF INSULATOR SAFETY FACTOR SHOWS 1.33 AND 1.38 FOR THE TWO QUALIFICATION BSMS WHICH COMPLIES WITH THE FACTOR OF SAFETY REQUIREMENT (1.25) OF 10SPC-0067 PARA. 3.2.1.2.3.7 (REFERENCE "BSM DELTA QUALIFICATION 2 FINAL REPORT" PARAGRAPH 6.3.3), COLD 30 DEGREE MOTOR.

CAUSE & CORRECTIVE ACTION

ITEM:	CAUSE CODE:	CAUSE NARRATIVE:	CA CODE:	CORRECTIVE ACTION NARRATIVE:
01	10	THE DESIGN DOES NOT MEET PERFORMANCE GOAL ESTABLISHED IN THE DELTA QUALIFICATION 2 TEST PLAN.	30	NO CORRECTIVE ACTION REQUIRED. THE TEST RESULTS HAVE BEEN DETERMINED TO COMPLY WITH 10SPC-0067 DESIGN REQUIREMENTS. REFERENCE DISPOSITION RATIONALE.

640A

WAIVERS/DEVIATIONS - FORWARD MOTORS - Lot AAY

NOMENCLATURE	PART NUMBER	SERIAL NO	NCR	VMRR	DAR
Motor Case, Loaded	B12002-02-01	1000738	D10909		
Case/Aft Closure	B12018-02-01	I0511	B13616 (superseded by B19943)		
Case/Aft Closure	B12018-02-01	I0511	B19943		
Adapter, Igniter	B12016-02-02	5569	D05044		
Nozzle Assembly	B12003-09-01	W0442	D11927	006185	
Nozzle Assembly	B12003-09-01	W0442	D11959	006186	
Closure, Aft	B12018-14-01	W0442	D10275		
Anti-Oxidant	SE0724	Lot 20 All Motors	D08388		
HX-752	SE0754	Lot 50 All Motors	D08262		
Nozzle Assembly	B12003-09-01	W0442	D14416		

DATA ACCEPTANCE REC...

TITLE: LOADED MOTOR - BSM

REL. #: MRC256476-02

PART #: B12002-02-01

DAR REV.: B

ITEM	CAT	ZONE	METHODS	CODE	SOURCE	INSPECTION INSTRUCTIONS	DATA MANAGEMENT: DESIGN LIMITS MIN.	DESIGN LIMITS MAX.	DATA RECORDING	FINAL ACCEPTANCE: OPERATOR STP-DT	QUALITY STP-DT	CUST STP-DT
D014	III	NOTED	VIS	REC	C1	MANDREL EXTRACTION FORCE AND NET PROPELLANT WEIGHT. (PCS 044618)	—	5000 LBF SEE TABLE BELOW	75.3 LBS. 78.3 LBS.			

D014	D014(A)	D014(B) MANDREL REMOVAL (SE0727, Para. 3.9.1) (2100 psig HANNIFIN MODEL 88-H11C) (725 psig SHEFFER CYLINDER 3 1/4 MH-RHF-5-CC)		D014(C) MOTOR/PROPELLANT CAST WEIGHT 75.3 - 78.3 LBS. (Dwg. Note 2)			
CASE S/N	MOTOR I.D. (Dwg. Note 1) OPS	REMOVAL FORCE	OPS	CASE + PROPELLANT LBS.	LINED CASE LBS. (SEE D001(F)	NET WEIGHT PROPELLANT	
I0510	P 132 C S 3-30-93	PSI 600 LBF 4200	P 66 C S 2-25-93	122.5	45.8	76.7	P 7 C S 128 CSD MAR 3 0 1993 MAR 3 0 1
I0511	P 132 C S 3-30-93	PSI 600 LBF 4200	P 66 C S 2-25-93	122.3	45.6	76.7	P 7 C S 128 CSD MAR 3 0 1993 MAR 3 0
I0512	P 132 C S 3-30-93	PSI 550 LBF 3750	P 66 C S 2-25-93	122.5	45.7	76.8	P 7 C S 128 CSD MAR 3 0 1993 MAR 3
I0682	P 132 C S 3-30-93	PSI 550 LBF 3750	P 66 C S 2-25-93	122.3	45.5	76.8	P 7 C S 128 CSD MAR 3 0 1993 MAR 3

642

CONFIGURATION, AS BUILT FWD BOOSTER SEPARATION MOTOR
USBI P/N N/A
APPLICABLE TO LOT AAY

COMPONENT	PART NO.	REV	ECO'S	SERIAL NUMBERS
ROCKET MOTOR ASSEMBLY	B12000-13-01	*1		1000 738
LOADED CASE CASE AND AFT CLOSURE ROCKET MOTOR CASE	B12002-02-01 B12018-02-01 B12001-02-01	N E E	29665, 31077 31597	I0511
IGNITER ASSEMBLY IGNITER ADAPTER	B12011-06-01 B12016-02-02	*1 B		5569
TRANSDUCER PORT PLUG	B13348-01-01	A		N/A
$BKNO_3$ GRANULES, BAGGED	B12017-03-01	D		N/A
TBI PORT PLUG, RED	BC-20003-01	-		N/A
IGNITER CASE	B12014-01-02	B	26527, 27492	5563
RETAINER BOOSTER CHARGE	B12015-03-01	B	27662	5520
CENTERING INSERT	B12400-01-01	A	27379	N/A
IGNITER GRAIN GRAIN SUPPORT ROD	B12350-02-01 B12349-02-01	B A	27378, 28084	5514
NOZZLE ASSEMBLY AFT CLOSURE/NOZZLE SHELL FORGING	B12003-09-01 B12006-02-01 B12007-01-01	*1 D A	27623, 27372	W0442
CLOSURE INSULATION	B20748-01-01	A		N/A
THROAT INSERT	B12004-02-01	*1		0002
EXIT CONE	B12005-04-01	G		6683
WEATHER SEAL	B12099-01-01	B		N/A

...-01
...M LOADED MOTOR
NO: N/A
MFG PART NM: N/A
PLAN SER NO: N/A
PROJECT REL: MULT
PROJECT NO: 5597
BUILDING: 0700
WORK AREA: PBS

REF NO: N/A

PR/MRB: MRB WC/OB:

REPORT DATE: 09/02/93

NCR DATE:
DISPOSITION DATE: 03/09/93
CLOSE DATE: 08/18/93
DPRO COMMENTS: YES 08/19/93

INSPECTOR		MARK RADOVIC	04/30/93
VALIDATION		MIKE KISKILA	04/14/93
DISPOSITION		LARRY MURPHY	08/18/93
CAUSE/CA (UTC)		RICHARD DOUGLAS	08/09/93
CAUSE/CA (VEN)		N/A	
QUAL DES ENGR		MIKE KISKILA	
CUSTOMER		DWAYNE W. WILSON	
GOVT REP			
MFG ENG REWORK		RAYMOND CORREA	08/18/93
PURCH BUYER		N/A	08/18/93
INSP ACCEPT		MARK RADOVIC	
			08/19/93
			08/19/93
			08/19/93

UOM:
LOT SIZE: EA PO:
REJECT NO: 64 VENDOR NO: 000000
CAR/FRR: 36 VEND NAME:
VEND DOC NO: N/A

NCR NARRATIVE

MRC256472,S/N1582,1596,1586,1534,1549,1536
SEE INTERIM DISPOSITION #1 - CONTINUE PROCESSING INTO PHASE III OP 20 AND
THROUGH LAT. MK 3/12/93
MRC256470 S/N 1568,MRC256469 S/N 1609, S/N 10770, S/N 1546, 1547
S/N 10719, S/N 10619, S/N 1598, S/N 1588,MRC256476 S/N 1599,S/N 1691,
10684,10557,10573,10567,10511, S/N 1694, MRC256475 S/N 10512, S/N 1070S
10620,10624,MKR 04/30/93 CONT... MRC256473 S/N 10667,1593,1585,10648,10616,
10572,MRC 256471 S/N

ITEM INFORMATION

ITEM:	OPER NO:	AFF QTY:	SERIAL NO:	DWG SPEC:
01	0016	36	MULT.	NOTE 8

DISCREPANCY & DISPOSITION

DEFECT CODE: 355 26

RESP ORGN: 21200

OCC/REC: N

DISP CODE: A

DISP QTY 36

ITEM: 01

S/B:NONE ALLOWED IS:VISUAL INSPECTION REVEALS NON HOMOGENOUS PROPELLANT.

DISCREPANCY DESCRIPTION:

USE-AS-IS. DISPOSITION DESCRIPTION:
PROPELLANT ARE INHERENT IN THE MIXING AND CASTING PROCESS.
USE OF PROPELLANT WITH VOID CRITERIA IS ACCEPTABLE AS EVIDENCED BY THE
THE 3/8 INCH VOID CRITERIA IS AREAS WHICH ARE SMALLER THAN
ACCEPTABLE PERFORMANCE OF LOTS AAU, AAW, AAX AND AAY. (~>)
LOT VMRR'S ARE AAU-006164, AAW-006173, AAX-006180. THE 3/8
INCH REQUIREMENT COMES FROM SE 0727 PROP. PROC. SPEC.
THE BALLISTIC PERFORMANCE OF ALL OF THESE LOTS HAS BEEN NOR-
MAL AND WITHIN FAMILY AT THE 30 DEGREE AND 120 DEGREE FIRING
TEMPERATURES. LOTS AAU, AAW AND LOT AAX WERE ALSO EVIDENCED BY THE
BY HIGH SPEED FILM TO DETERMINE IF ANY GENERATED DEBRIS WAS
OBSERVABLE. THERE WAS NONE. THE SPOTS NOTED ON THE AFT MA-
CHINED PROPELLANT SURFACE OF LOT AAY MOTORS WERE SO SMALL,
(<0.010 INCH DIAMETER), THAT CLOSE VISUAL INSPECTION WAS RE-
QUIRED TO MAP THEM. THE QUANTITY ON EACH MOTOR WAS ALSO
VERY LOW (SEVERAL). SMALL AREAS OF PROPELLANT OF THIS TYPE
WILL NOT AFFECT MOTOR PERFORMANCE.

CAUSE & CORRECTIVE ACTION

TEM: CAUSE CAUSE NARRATIVE:

CA CORRECTIVE ACTION NARRATIVE:

01 CODE: 40 SEE CAR CAXX131.

DISC CAT: MT REF NO: N/A PR/MRB: MRB WC/OB: REPORT DATE: 09/02/93

CODE: 40 PCS 44596 WAS APPROVED ON 3/25/93 AND IS IN THE SYSTEM. THIS PCS LOWERS THE THRESHOLD FOR HOLDING DURING THE AP ADD FROM 10-TO-12 KW TO 8-TO-10 KW. WE HAVE NOT YET MADE A PROPELLANT BATCH WITH THIS PCS IN PLACE.

HH 1-21

COMPLETED

B147743

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

Non-Conformance Report

1 CSD VENDOR ✓ | 2 DISCREPANCY CATEGORY: ☐ Mfg/Test ☐ Design Dev ☒ QA / Supplier ☐ Suspect Failure ☐ GFP ☐ Launch Site ☐ Tooling (AGE) | 3 REFERENCE NO N/A mcs 11/4/00 | 4 NCR NO B 13616 | 5 PAGE 1

6 MFG END ITEM NAME	7 MFG END ITEM P/N	8 MFG END ITEM S/N	9 JOB / PLAN / PROC	10 PROJECT	11 LOCATION	CRIB
N/A	N/A	N/A	B17305	5332	SAN JOSE	~~B 2~~

12 DISCREPANT ITEM NAME	13 DISCREPANT ITEM P/N	14 VENDOR NAME / CODE	15 RECEIVER / P O NO & LINE ITEM	16 UNIT OF MEAS	LOT SIZE	NO REJECTED
CASE MATCHED SET CLOSURE	B12018-02-01	THIEM-IND/04125	210397-2:00	EA	64	64

17 ITEM	18 OP NO	19 QTY AFFECTED	20 SERIAL NUMBER	DISCREPANCY / APPLICABLE SPECIFICATIONS 21 DRWG ZONE SPEC PARA	22 DIMENSION SPEC NOMINAL	23 TOLERANCE LIMITS	24 DESCRIPTION	25 DEFECT CODE	26 RESP ORGN	27 RECURR
1	N/A	64	SEE CONTINUATION SHT mcs 9/14/00	~~H~~ 2 mcs 9/20/00 STD500 method 11B	2 mcs 9/20/00 Design Code, P/N, S/N, rev letter + Mfg Code	NONE	~~ITEM 1 MARKING~~ mcs 9/20/00 REV. LETTER (E) OMITTED ~~Plus MFG~~ mcs 9/20/00 ~~MARK~~ mcs 9/20/00 ~~TRADENAME OR NAME ON ITEMS 4 & 5~~ mcs 9/20/00 Mfg code identification missing from item 4 (B12018-13-01 Case Subassembly) ~~SEE CONTINUATION SHT~~ mcs 9/20/00	01014	VEND	N/A

28 ORIGINATOR	DATE	29 QUALITY ENGINEER	DATE	30 OPERATIONS	DATE	31 CUSTOMER	DATE
M Nooby	9/7/00	MC Schumacher	9/21/00	N/A mcs		N/A mcs	

32 SUPPLIER ONLY INFO: DWG REV E; CODE 29665

33 NARRATIVE: ~~*CSD is the design activity/agency~~ mcs 9/20/00 Set/serial NOS - 649, 622, 543, 6008, 6061, 578, 6082, 709, 6036, 724, 620, 608, 704, 518, 630, 540, 689, 511, 624, 512, 522, 657, 520, 562, 579, 526, 6516, 527, 595, 321, 572, 690, 683, 576, 573, 674, 560, 559, 719, 524, 557, 576, 684, 726, 6060, 623, 687, 510, 577, 623A, 6016, 617, 514, 618, 5516, 705, 637, 708, 608, 722, 721, 580, 535 + 567. (ALL S/N PREFIXED BY "I") mcs 9/20/00

*(2) identification applies to item 4 only MC Schumacher 9/23/00

THIS NCR SUPERSEDED BY NCR B19945 TO ACCOMODATE NMO REJECTION MC Schumacher 11/1/00

34 C/A / CAR / FRR: ☐ No C/A req'd ☐ CAR ☐ FRR ☑ C/A (Refer to the last page of this form)

35 ITEM	36 QTY	37 DISP CODE	38 ITEM DISPOSITION	39 OPERATIONS	40 QUALITY
				11-8-00	

41 DISPOSITION AUTHORITY: ☐ PR ☑ MRB ☐ Major

42 THIS DISPOSITION DOES NOT ADVERSELY AFFECT: ☐ Safety ☐ Weight ☐ Performance ☐ Reliability ☐ Interchangeability

DISPOSITION APPROVALS

43 ENGINEERING	DATE
44 OPERATIONS	DATE
45 QUALITY ASSURANCE	DATE
46 OTHER	DATE
47 CUSTOMER	DATE
48 AFQA POST REVIEW	DATE

IF A WAIVER IS GRANTED THE FOLLOWING STATEMENT APPLIES This approval does not constitute a waiver on the part of the government for any claim for equitable price adjustment as the contracting officer may deem appropriate because of such waiver or deviation. This disposition does not establish a precedent for future dispositions

B 13616

647

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

NCR Discrepancy Continuation Sheet

12 DISCREPANT ITEM: CASE MATCHED SET CLOSURE | 13 DISCREPANT ITEM P/N: B12018-02-01 | 28 ORIGINATOR: M DALY | DATE: 9/7/88 | 4 REF NCR NO: B13616 | 5 PAGE: 2

17 ITEM	18 OP NO	19 QTY AFFECTED	20 SERIAL NO	21 DISCREPANCY / APPLICABLE SPECIFICATION DRWG ZONE SPEC PARA	22 DIMENSION SPEC NOMINAL	23 TOLERANCE LIMITS	24 DESCRIPTION	25 DEFECT CODE	26 RESP ORGN	27 DISPOSITION
2	N/A	2	SEE CONT. SHT 502 + 557	12 G SHT 10	16	NONE	ITEM 2 CONVERSION COAT OMITTED CLOSURE SET # 562 DIA 11.566-11.564 (SEE PG 7 AND DWG B12006-02-01 ZONE 8-E-C) CASE SET # 557 FORWARD END ON 3.530 DIA, APPROX 1" DIA SEE (See dwg B12018, zone 7/c)	13514	VEND	N/A
	N/A	1		12 G SHT 10	16	NONE				
3	N/A	3	657, 690 + 708	G 8 3	2A	NONE	ITEM 3 NICKS ON PRIMERY ORING SEAL FROM DOWEL PIN CLOCK WISE (Aft looking fwd) at 120° (S/N 657), 35° (S/N 708) + 30° (S/N 690). See pg 9. SET # 657 APPROX 120° SET # 708 35° SET # 690 30° WORST CONDITION NICK .005 DEEP	25034	VEND	N/A
4	N/A	3	704, 526 + 595	6 E 3 B12006-02-01		NONE	ITEM 4 NICKS ON THRDS (Care to closure threads, see pg 7.) CLOSURE SET # 595 704 526	24534	VEND	N/A
5	N/A	1	520	8 G 125 B12001-02-01 Visual	MAX NONE		ITEM 5 SCRATCHES SET # 520 ON 11.954 DIA ALL AROUND .005 DP (See pg 9)	25070	VEND	N/A

UNITED TECHNOLOGIES

NCR Discrepancy Continuation Sheet

9

12 DISCREPANT ITEM ... NE: MATCHED SET CASE Closure

13 DISCREPANT ITEM P/N: B 12018-02-01

28 ORIGINATOR: M DALY

DATE: 9/7/88

4 REF / NCR NO: B13616

5 PAGE: 3 OF

17 ITEM	18 OP NO	19 QTY AFFECTED	20 SERIAL NO	DISCREPANCY / APPLICABLE SPECIFICATIONS 21 DRWG / ZONE SPEC PARA	22 DIMENSION SPEC NOMINAL	23 TOLERANCE LIMITS	24 SET #	DESCRIPTION 1	2	3	4	5	25 DEFECT CODE	26 RESP ORGN	27 RECURR
							619	X							
							622	X							
							543	X							
							668	X							
							661	X							
							578	X							
							682	X							
							709	X							
							636	X							
							724	X							
							620	X							
							658	X							
							704	X		9/7/88	X				
							518	X							
							630	X							
							540	X							
							689	X							
							511	X							
							624	X							

* mos 9/20/88

3 REFERENCE NO

649

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

NCR Discrepancy Continuation Sheet

12 DISCREPANT ITEM NAME	13 DISCREPANT ITEM P/N	28 ORIGINATOR	DATE	4 REF / NCR NO	5 PAGE	OF
CASE MATCHED SET CLOSURE	B12018-02-01	M. DALY	9/7/88	B13616	4	4

17 ITEM	18 OP NO	19 QTY AFFECTED	20 SERIAL NO	DISCREPANCY / APPLICABLE SPECIFICATIONS 21 DRWG / ZONE SPEC PARA	22 DIMENSION SPEC NOMINAL	23 TOLERANCE LIMITS	24 SET #	DESCRIPTION 1	2	3	4	5	25 DEFECT CODE	26 RESP ORGN	27 RECURR
							512	X							
							522	X							
							657	X		X					
							520	X				X			
							562	X	X						
							579	X							
							526	X		~~X~~ 9/7/88	X				

MCS 9/20/88

650

3 REFERENCE NO

UNITED TECHNOLOGIES

NCR Discrepancy Continuation Sheet

12 DISCREPANT ITEM	13 DISCREPANT ITEM P/N	28 ORIGINATOR	DATE	4 REF / NCR NO	5 PAGE	OF
MATCHED SET CASE Closure	B12018-02-01	M. DAly	9/7/88	B13616	5	6

17 ITEM	18 DWG NO	19 QTY AFFECTED	20 SERIAL NO	DISCREPANCY / APPLICABLE SPECIFICATIONS 21 DRWG ZONE SPEC PARA	22 DIMENSION SPEC NOMINAL	23 TOLERANCE LIMITS	24 SET #	DESCRIPTION 1	2	3	4	5	25 DEFECT CODE	26 RESP ORGN	27 RECURR
							656	X							
							527	X		9/7/88					
							595	X			X				
							521	X							
							572	X							
							690	X		X					
							683	X							
							575	X							
							573	X							
							674	X							
							560	X							
							559	X							
							719	X							
							524	X							
							557	X	X						
							576	X							
							684	X							
							726	X							
							660	X							

* WCS 9/20/88

3 SETTLEMENT NO

651

UNITED TECHN

NCR Discrepancy Continuation Sheet

9

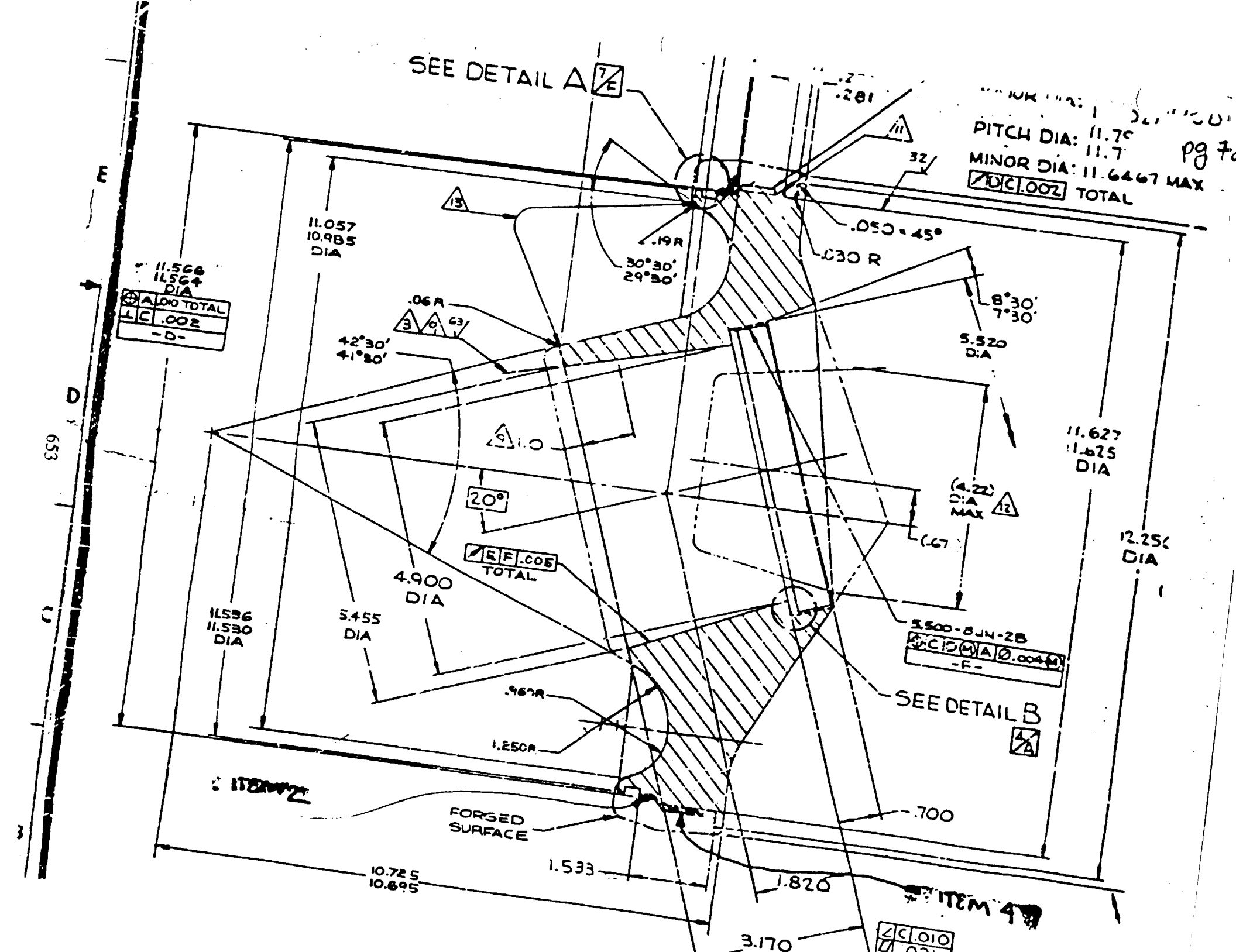
12 DISCREPANT ITEM NAME	13 DISCREPANT ITEM P/N	28 ORIGINATOR	DATE	REF NCR NO	5 PAGE	OF
MATCHED SET CASE Closure	B12018-02-01	M DALY	9/7/88	B 13616	6	8

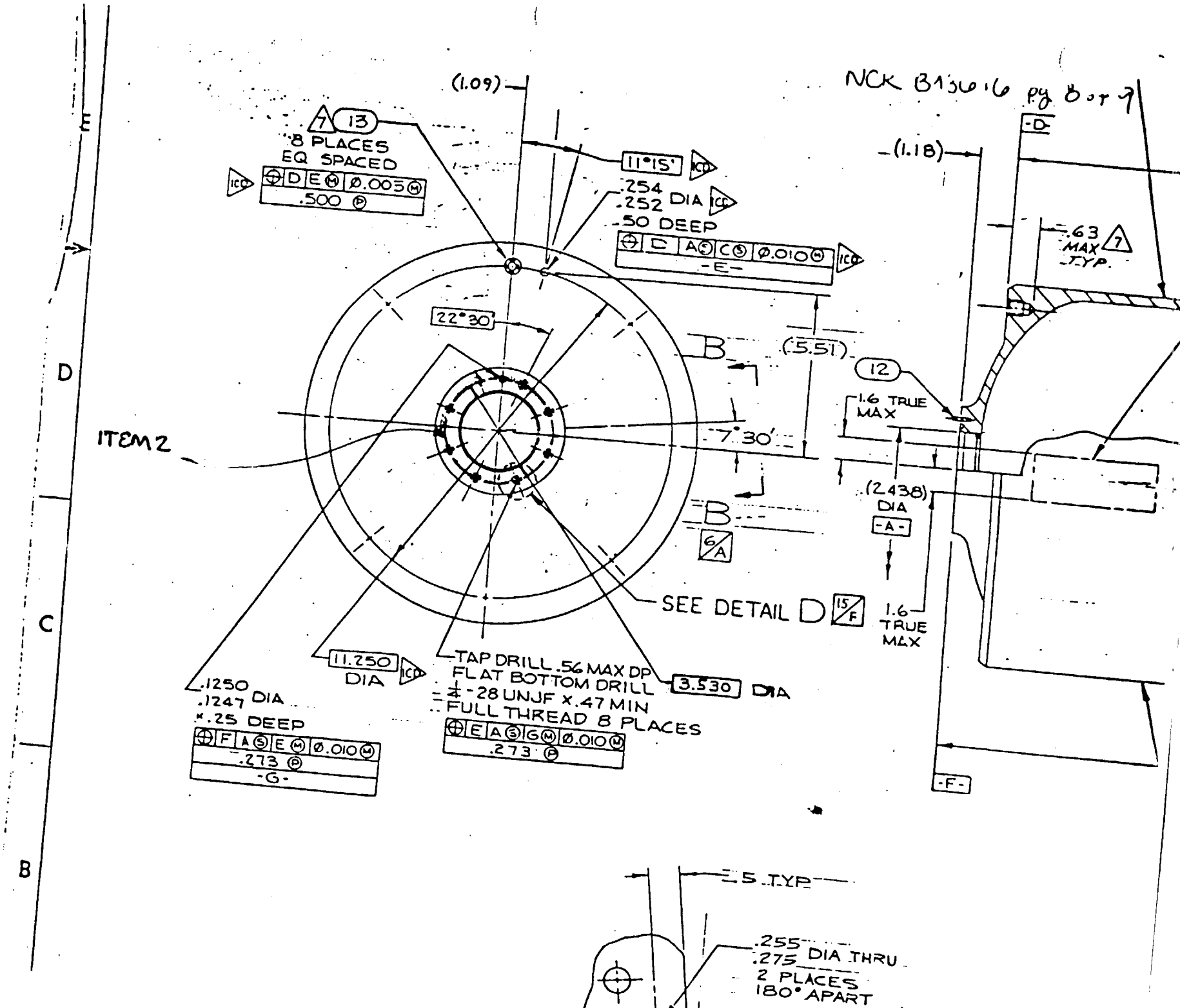
17 ITEM	18 OP NO	19 QTY AFFECTED	20 SERIAL NO	DISCREPANCY / APPLICABLE SPECIFICATIONS 21 DRWG ZONE SPEC PARA	22 DIMENSION SPEC NOMINAL	23 TOLERANCE LIMITS	24 SET #	DESCRIPTION 1	2	3	4	5	25 DEFECT CODE	26 RESP ORGN	27 RECURR
							623	X							
							687	X							
							510	X							
							577	X							
							634	X							
							616	X							
							617	X							
							514	X							
							618	X							
							556	X							
							705	X							
							637	X							
							708	X		X					
							608	X							
							722	X							
							721	X							
							580	X							
							555	X							
							567	X							

* mcs 1/20/89

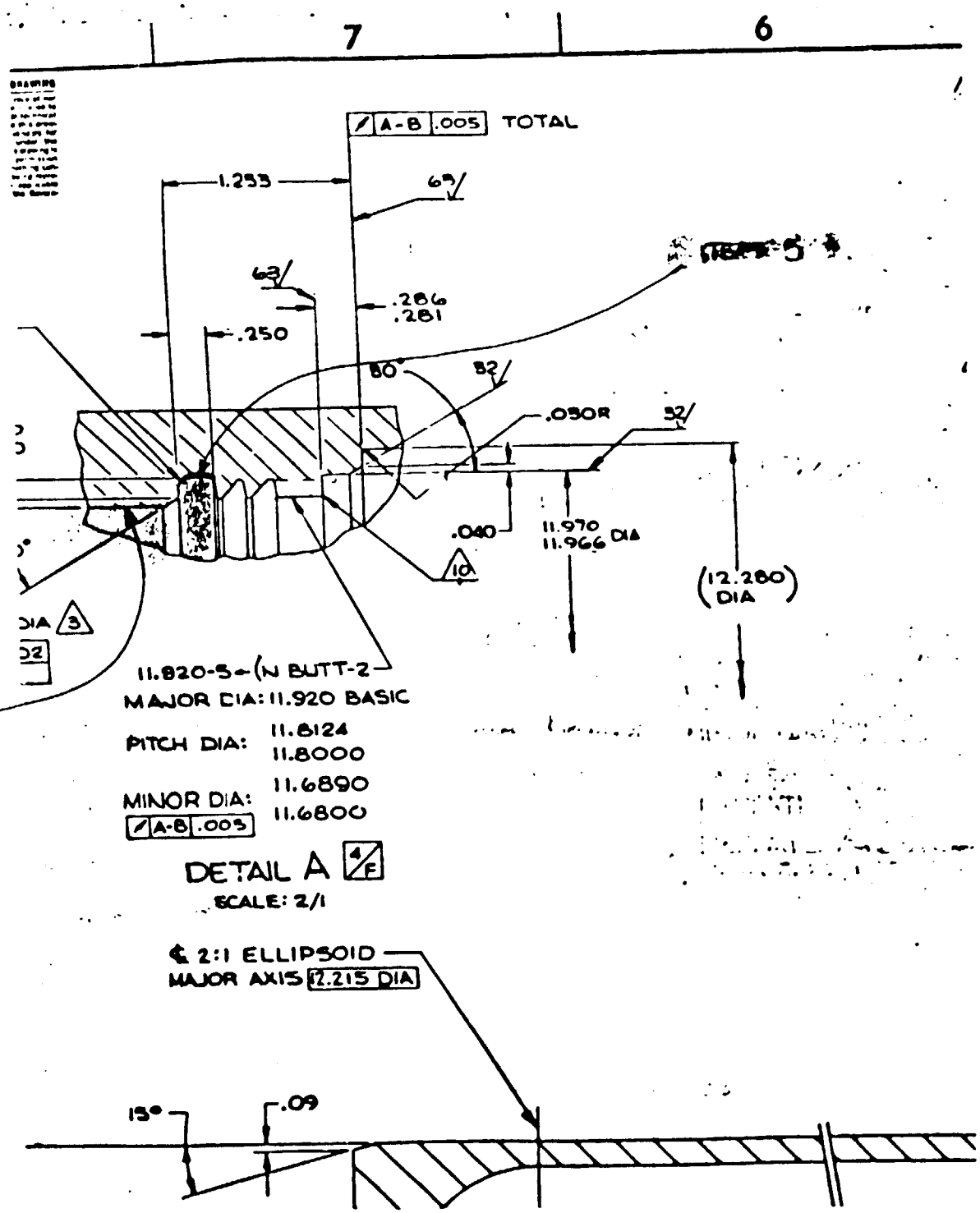
652

J REFERENCE NO


SEE DETAIL A
PITCH DIA: 11.7
MINOR DIA: 11.6467 MAX
C .002 TOTAL
.281
.050 x 45°
.030 R
.19R
30°30'
29°30'
.06 R
42°30'
41°30'
8°30'
7°30'
11.057
10.985
DIA
11.566
11.564
DIA
A .010 TOTAL
C .002
-D-
5.520
DIA
11.627
11.625
DIA
1.0
20°
(4.22)
DIA
MAX
12.25
DIA
E F .005
TOTAL
4.900
DIA
11.536
11.530
DIA
5.455
DIA
5.500-8JN-2B
C D M A Ø.004 M
-F-
SEE DETAIL B
.969R
1.250R
ITEM 2
FORGED
SURFACE
.700
10.725
10.695
1.533
1.826
ITEM 4
3.170
C .010


NCK B136016 pg 8 of 9
(1.09)
7 13
8 PLACES
EQ SPACED
D E M Ø.005 M
.500 P
11°15'
.254
.252 DIA
.50 DEEP
D A S C S Ø.010 M
-E-
22°30'
B
(5.51)
7°30'
B
6/A
ITEM 2
12
1.6 TRUE
MAX
(2.438)
DIA
-A-
SEE DETAIL D 15/F
1.6
TRUE
MAX
-D-
(1.18)
.63
MAX
TYP.
7
-B-
-F-
11.250
DIA
.1250
.1247
x.25 DEEP
F A S E M Ø.010 M
.273 P
-G-
TAP DRILL .56 MAX DP
FLAT BOTTOM DRILL
¼-28 UNJF x.47 MIN
FULL THREAD 8 PLACES
E A S G M Ø.010 M
.273 P
3.530 DIA
.5 TYP
.255
.275 DIA THRU
2 PLACES
180° APART
E
D
C
B

NUR. 1513610 Pg 401



ITEM 3

655

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

Non-Conformance Report

1 CSD VENDOR ✓ | 2 DISCREPANCY CATEGORY: ☐ Mfg/Test ☐ Design Dev ☐ S ☐ ilure ☐ GFP ☐ Launch Site ☐ Tooling (AGE) | 3 REFERENCE NO. | 4 NCR NO. B136 | 5 PAGE 1

6 MFG END-ITEM NAME | 7 MFG END-ITEM P/N | 8 MFG END-ITEM S/N | 9 JOB/PLAN/PROC. | 10 PROJECT | 11 LOCATION 4N | CRIB

12 DISCREPANT ITEM NAME | 13 DISCREPANT ITEM P/N | 14 VENDOR NAME/CODE | 15 RECEIVER/P.O. NO. & LINE ITEM | 16 UNIT OF MEAS. | LOT SIZE | NO. REJ.

17 ITEM	18 OP NO	19 QTY AFFECTED	20 SERIAL NUMBER	DISCREPANCY/APPLICABLE SPECIFICATIONS 21 DRWG ZONE SPEC PARA	22 DIMENSION SPEC NOMINAL	23 TOLERANCE LIMITS	24 DESCRIPTION	25 DEFECT CODE	26 REWORK CODE	27

28 ORIGINATOR | DATE | 29 QUALITY ENGINEER | DATE | 30 OPERATIONS N/A | DATE | 31 CUSTOMER N/A

51 ITEM	52 CAUSE NARRATIVE	53 CAUSE CODE	54 CORRECTIVE ACTION NARRATIVE	55 C/A
1.5	Workmanship	23	Vendor notified	

FUNCT ORGN N/A-QS | DATE | QUALITY | DATE 9/23/08 | 4 NCR NO. B 136

CSD 1138 (R7/05)

656

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

Non-Conformance Report

AH-2-3 8/8/89

24 MAC ORD

5593-101-0000
5592-210

FWD AFJ

1 CSD VENDOR	2 DISCREPANCY CATEGORY					3 REFERENCE NO	4 NCR NO	5
✓	☐ Mfg/Test ☐ Design Dev	☐ Suspect Failure ☐ GFP ☐ Launch Site ☑ A I /Supplier ☐ Tooling (AGE)					B 19943	

6 MFG END-ITEM NAME	7 MFG END-ITEM P/N	8 MFG END-ITEM S/N	9 JOB/PLAN/PROC	10 PROJECT	11 LOCATION	CRIB
N/A	N/A	SEE BLK 33	B17305	5592	SAN JOSE	R

12 DISCREPANT ITEM NAME	13 DISCREPANT ITEM P/N	14 VENDOR NAME/CODE	15 RECEIVER/P O NO & LINE ITEM	16 UNIT OF MEAS	LOT SIZE
MATCHED CASE - NOSE	B12018-02-01	THIEM IND / 04125	210397 - 2.00	EA	64 / 64

17 ITEM	18 OP NO	19 QTY AFFECTED	20 SERIAL NUMBER	DISCREPANCY/APPLICABLE SPECIFICATIONS 21 DRWG ZONE SPEC PARA	22 DIMENSION SPEC NOMINAL	23 TOLERANCE LIMITS	24 DESCRIPTION	25 DEFECT CODE	26 RESP ORG
1	N/A	64	SEE BLK 33	(1)+ STD SC ~~Nameplate TYPE III~~	Design Cfg P/N S/N ~~Per letter~~ +Mfg Code	NONE	~~Per letter ("E") omitted~~ + Mfg code missing from item 4 (B12018-13-01, Case Subassembly)	CN14	VEND
2	N/A	2	562 + 557	16	100% Cover Coat	NONE	Coating omitted from 11.5" - 11.54 dia of S/N 562 and 13.530 dia of S/N 557	13514	VEND

28 ORIGINATOR	DATE	29 QUALITY ENGINEER	DATE	30 OPERATIONS	DATE	31 CUSTOMER	DATE
D M Davis	11/1/88		11/1/88	N/A		N/A	

32 SUPPLIER ONLY INFO
DWG REV E
ECOs 29665

33 NARRATIVE THIS NCR SUPERSEDES NCR B19916 TO ACCOMMODATE NMC REJECTION S/N/Serial Nos - (619)(623), 543, 666, 661, 578, (665), 649, 634, 724, (532), (656), 764, 516, 663, 521, (515), 521, 573, 690, 685, (575), (573), 674, 560, 559, (714), 524, (551), 576, (664), 726, 666, (623), (668), (510), 517, 634, (616), (617), 514, 618, 556, 565, 687, (729), 665, 722, (721), (582), 555 & (567). ALL S/Ns preceded by prefix I.
(*(2) identification applies to item 4 only.) ALSO S/N's 540, 689, 511, (624), (512), 522, 657, 520, 562, 579, 526 AND 656. 7589 4-4-89

34 C/A / PREV
☐ No C/A
☐ CAR
☐ FNR
☐ C/A ... the last ... this ...

35 ITEM	36 QTY	37 DISP CODE	38 ITEM DISPOSITION	39 OPERATIONS	40 QUALITY
			FINAL DISPOSITION ON NCR DISPOSITION CONTINUATION SHEET.		

RECEIVED
JUL 28 1989
N.M.O.

FILE 2.4.6

41 DISPOSITION AUTHORITY ☐ PR ☑ MRB ☐ Major

42 THIS DISPOSITION DOES NOT ADVERSELY AFFECT ☒ Safety ☒ Weight ☒ Performance ☒ Reliability ☒

DISPOSITION APPROVALS

		DATE
43 ENGINEERING	Larry K. Chan	7/28/89
44 OPERATIONS	Paul R	4-4-89
45 QUALITY ASSURANCE	7589	DATE
46 OTHER	USBI: John Mack	DATE 4/5/89
47 CUSTOMER	AFDA: Anthony Lima	DATE 4-6-89
48 AFDA POST REVIEW		DATE

IF A WAIVER IS GRANTED THE FOLLOWING STATEMENT APP...

657

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

NCR Discrepancy Continuation Sheet

12 DISCREPANT ITEM: MATCHED SET, CASE-CLOSURE

13 DISCREPANT ITEM P/N: B12018-02-01

28 ORIGINATOR: MC Schumacher

DATE: 11/1/68

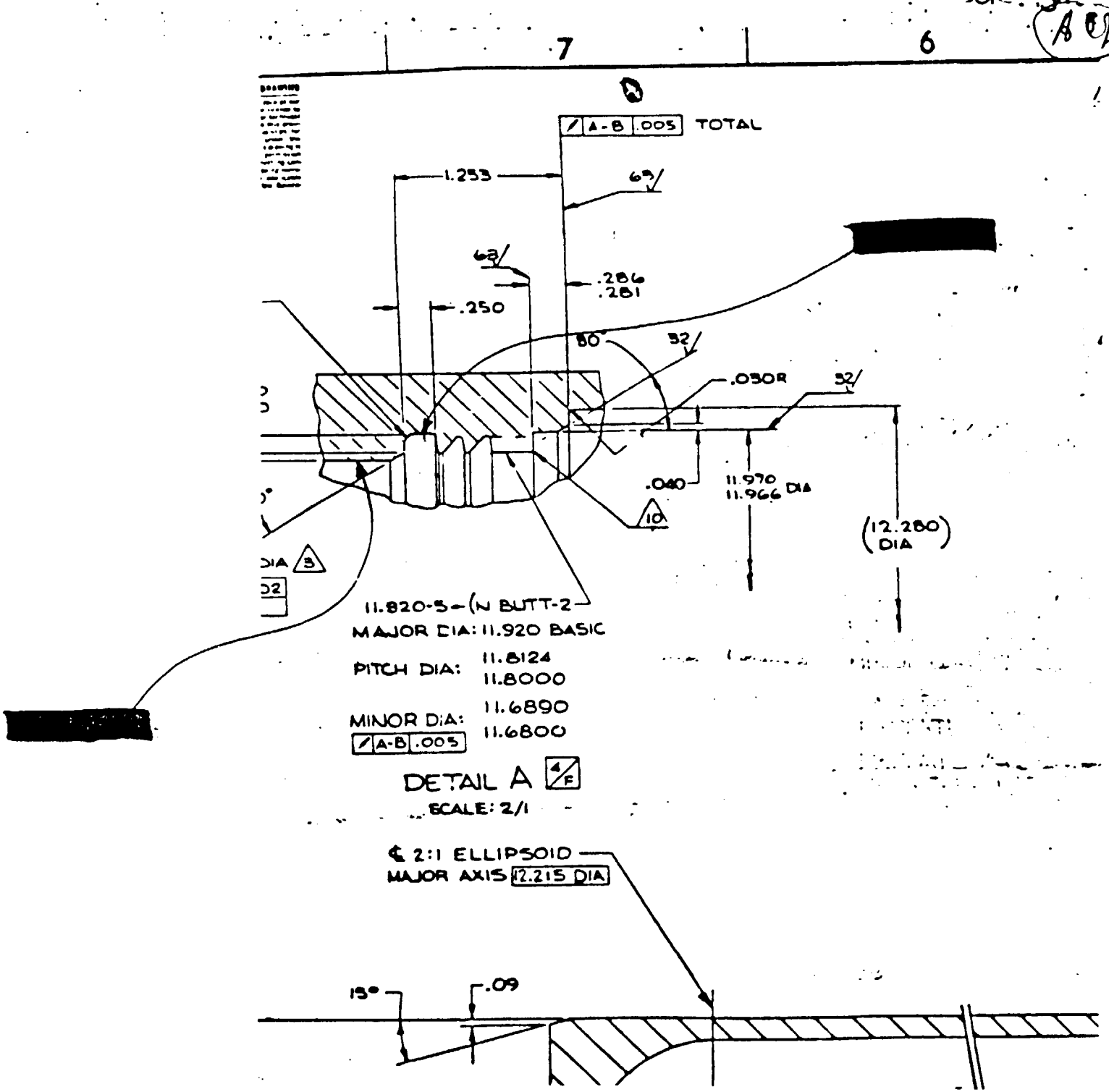
4 REF/INC NO: ~~B15010~~ B19943

5 PAGE: 2 OF 6

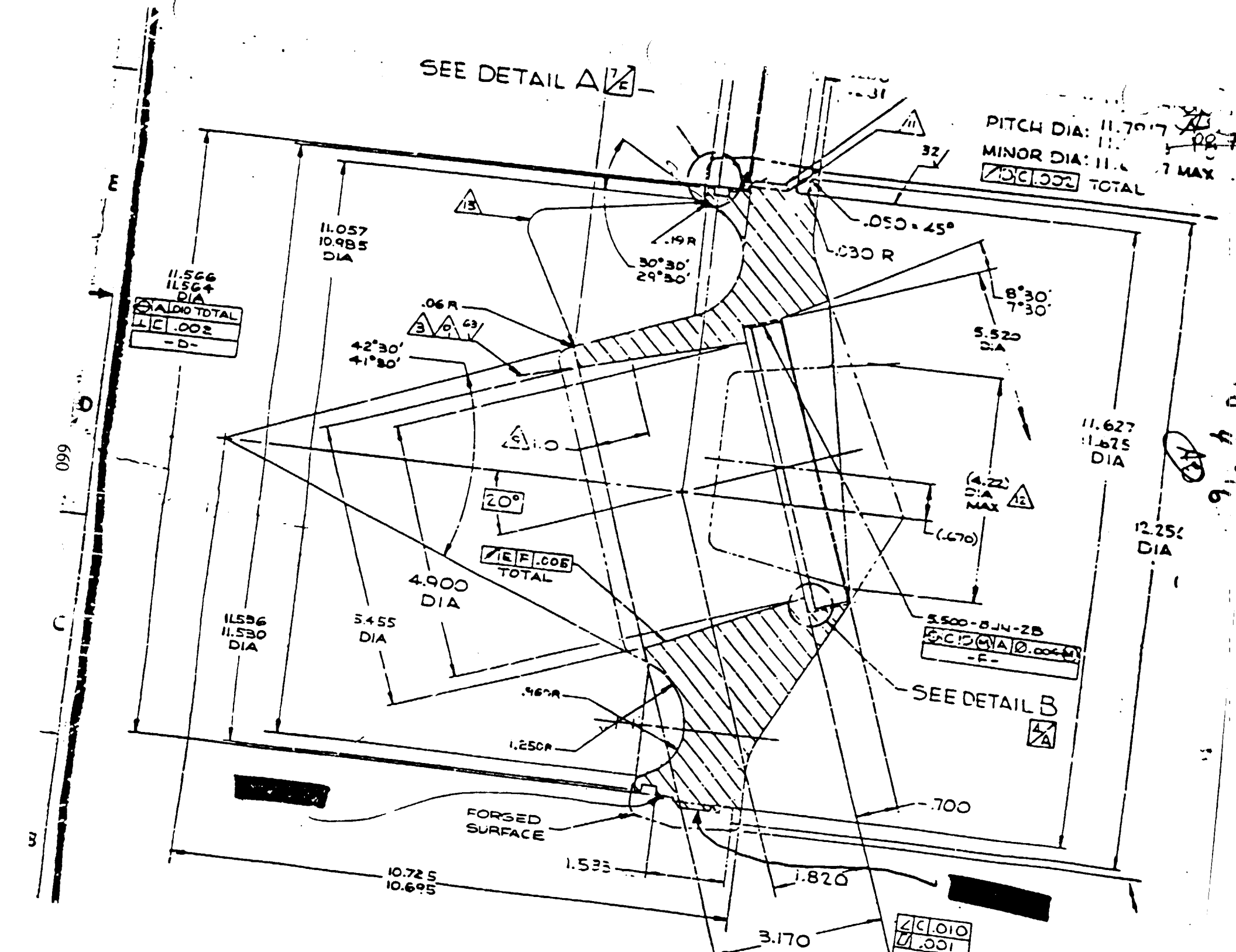
17 ITEM	18 OP NO	19 QTY AFFECTED	20 SERIAL NO	21 DISCREPANCY / APPLICABLE SPECIFICATIONS DRWG, ZONE SPEC, PARA	22 DIMENSION SPEC NOMINAL	23 TOLERANCE LIMITS	24 DESCRIPTION	25 DEFECT CODE	26 RESP ORIGN	27 RECURR
3	N/A	3	657, 690 & 708	(3) of B12006 G/6	Free of tool marks scratches	NONE	Nicks on O-ring surface at 120° (S/N 657), 35° (S/N 708) & 30° (S/N 690). Worst condition is 0.005dp locations are from dowel pin clockwise, aft looking fwd	25034	VEND	N/A
4	N/A	3	704, 526 & 505	6E B12006 (3)	"	"	Nicks on case to closure threads	24534	VEND	N/A
5	N/A	1	520	B6 Visual	125 ✓	Max	Scratches on 11.954 dia, 0.005 dp, 360° around	25070	VEND	N/A

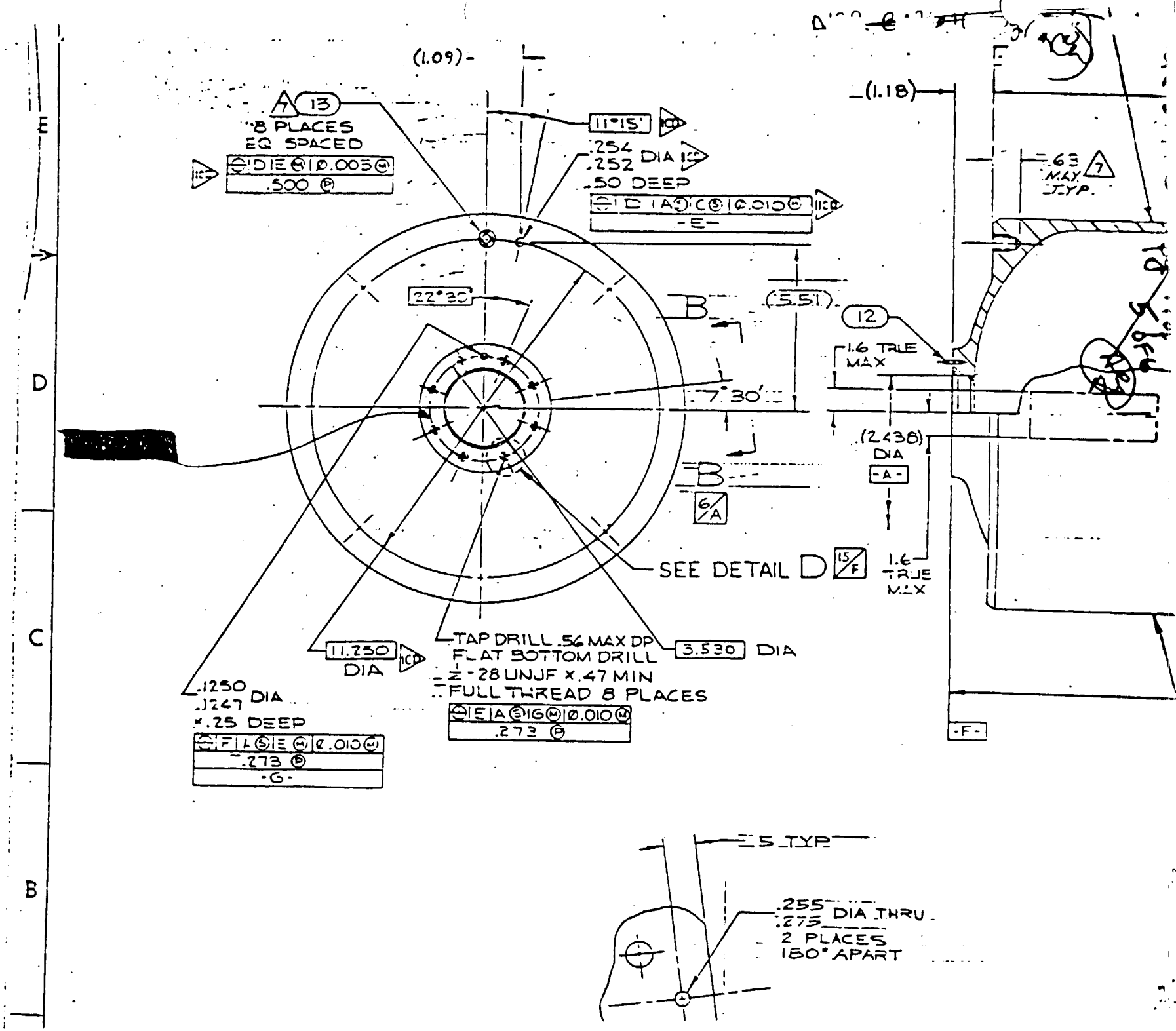
658

3 REFERENCE NO


7
6
D
A-B .005 TOTAL
1.253
63
68
.286
.281
.250
80°
32
.050R
32
.040
11.970
11.966 DIA
10
(12.280)
DIA
11.820-5-(N BUTT-2
MAJOR DIA: 11.920 BASIC
PITCH DIA: 11.8124
11.8000
MINOR DIA: 11.6890
11.6800
A-B .005
DETAIL A
SCALE: 2/1
℄ 2:1 ELLIPSOID
MAJOR AXIS 12.215 DIA
15°
.09

659


SEE DETAIL A
PITCH DIA: 11.70
MINOR DIA: 11.
TOTAL
.050 x 45°
.030 R
.19 R
30°30'
29°30'
.06 R
42°30'
41°30'
8°30'
7°30'
5.520
DIA
11.057
10.985
DIA
11.566
11.564
DIA
.010 TOTAL
.002
-D-
11.627
11.625
DIA
1.0
20°
(4.22)
DIA
MAX
(.670)
12.25
DIA
.005 TOTAL
4.900
DIA
11.536
11.530
DIA
5.455
DIA
5.500-8JH-2B
-E-
SEE DETAIL B
.460R
1.250R
FORGED
SURFACE
.700
1.533
1.820
10.725
10.695
3.170
.010
.001


(1.09)
(1.18)
A 13
8 PLACES
EQ SPACED
⌖ Ø.005 M A B C
.500 P
11°15'
.254
.252 DIA
.50 DEEP
⌖ Ø.010 M A C E
-E-
22°30'
B
(5.51)
12
1.6 TRUE MAX
.63 MAX TYP.
7°30'
(2.436) DIA
-A-
B
6/A
SEE DETAIL D 15/F
1.6 TRUE MAX
11.250 DIA
TAP DRILL .56 MAX DP
FLAT BOTTOM DRILL
¼-28 UNJF x .47 MIN
FULL THREAD 8 PLACES
3.530 DIA
⌖ Ø.010 M E A G
.273 P
.1250 DIA
.1247
x.25 DEEP
⌖ Ø.010 M F L E
.273 P
-G-
-F-
.5 TYP
.255
.275 DIA THRU
2 PLACES
180° APART
E
D
C
B

TECHNOLOGY

N Disp on
Continuation Sheet

12 DISCREPANT: MATCHED SET, CASE AFT CLOSURE
13 DISCREPANT ITEM P/N: B12018-02-01
28 ORIGINATOR: SONNY CHAN
DATE: 12/2/88
4 REF NCR NO: B19943
5 PAGE: 6

35 ITEM	36 QTY	37 DISP CODE	38 ITEM DISPOSITION	39 OPERATIONS	40 QUALITY
			FINAL DISPOSITION†		
1	64	RWK	REWORK TO DRAWING REQUIRMENTS	JUN 13 1989	296 CSD JUL 25 198
2	2	RWK	REWORK TO DRAWING REQUIREMENTS	JUN 13 1989	296 CSD JUL 25 198
3	3	RP	REPAIR: RUN FINGER TO CHECK NICKED SURFACE FOR RAISED METAL. REMOVE ANY FOUND BY HAND FILLING & BLENDING, THE OD AND ID OF O-RING GROOVE IS NOT AFFECTED AND WILL NOT AFFECT SEALING CAPABILITY OF O-RING SEAL. AFTER REPAIR TOUCH UP WITH ALODINE 1200 OR 1200S, RECORD QC TRACE # FOR ALODINE: QC3542 (C.C Hood 2-14-89)	JUN 13 1989	296 CSD JUL 25 198
4	3	RP	REPAIR: CHECK FOR RAISED METAL ON NICKED AREAS AND REMOVE BY BLENDING. THE THREAD PITCH DIAMETER IS NOT AFFECTED. AFTER REPAIR, TOUCH UP WITH ALODINE 1200 OR 1200S, RECORD QC TRACE # FOR ALODINE QC3542 (4-5-89) (4-5-89)	JUN 13 1989	296 CSD JUL 25 198
5	1	RP	REPAIR: REMOVE ANY RAISED METAL ON NICKED AREA BY BLENDING. 11.954 DIAMETER IS NOT VIOLATED AND WILL NOT AFFECT FIT OR FUNCTION OF PART. AFTER REPAIR TOUCH UP WITH ALODINE 1200 OR 1200S, RECORD QC TRACE # FOR ALODINE QC3542 APP 4-5-89	JUN 13 1989	296 CSD JUL 25 198

AFQC 2-26-89

662

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

Non-Conformance Report

1 CSD VENDOR ✓ | 2 DISCREPANCY CATEGORY ☐ Mfg/Test ☐ Design Dev ☐ Supplier ☐ Failure ☐ GFP ☐ Tooling (AGE) ☐ Launch Site

3 REFERENCE NO. B13616 | 4 NCR NO. B19[illegible]

6 MFG. END-ITEM NAME: N/A | 7 MFG. END-ITEM P/N: N/A | 8 MFG. END-ITEM S/N: SEE BLK 33 | 9 JOB/PLAN/PROC.: B17305 | 10 PROJECT: 5332 5592 | 11 LOCATION: SAN JOSE

12 DISCREPANT ITEM NAME: MATCHED ET CASE - CLOSURE | 13 DISCREPANT ITEM P/N: B12018-02-01 | 14 VENDOR NAME/CODE: THIEM IND / 04125 | 15 RECEIVER/P.O. NO. & LINE ITEM: 210397 20 | 16 UNIT OF ISSUE: EA | LOT NO.: CA

17 ITEM	18 OP NO	19 QTY AFFECTED	20 SERIAL NUMBER	DISCREPANCY / APPLICABLE SPECIFICATIONS 21 DRWG ZONE SPEC PARA	22 DIMENSION SPEC NOMINAL	23 TOLERANCE LIMITS	24 DESCRIPTION	25 DEFECT CODE	26
1	N/A	64	SEE BLK 33	(2) STD 00	Design Code P/N, S/N.	None	~~Per letter ("E") omitted~~ + Mfg code missing	23014	
2	N/A	2	562 + 551	(2)	100% Cover Coat	None	from item 4 (B12018-13) on Case Subassembly) Coating omitted from 11 Sep 1988 disp of S/N 562	23514	

28 ORIGINATOR: [illegible] Schumacher DATE: 11/1/88 | 29 QUALITY ENGINEER: [illegible] Schumacher DATE: 11/1/88

51 ITEM	52 CAUSE NARRATIVE	53 CAUSE CODE	54 CORRECTIVE ACTION NARRATIVE
1	~~See Cause statement on superseded NCR B13616 attached~~ WORKMANSHIP - [23] 4-4-89	23	~~See CA statement on superseded NCR B13616 attached~~ [4 23] VENDOR NOTIFIED 4-4-89

30 OPERATIONS: N/A DATE | 31 CUSTOMER: N/A

FUNCT ORGN: N/A mgr DATE | QUALITY: C A Schumacher M. P. Watts 4-4-89 DATE 11/1/88 | 4 NCR NO. B19[illegible]

CSD 1138 (87/05)

663

NCR: D05044 PLANT: SJO DISC CAT: MT REF NO: PR/MRB: MRB WC/OB: REPORT DATE: 07/26/93

DISC P/N: B12016-02-02
DISC P/NAME: ADAPTER,IGNITER
MFG PART NO: SAME
MFG PART NM: SAME
MFG SER NO: N/A
PLAN REL: MRA281499
PROJECT NO: 5596
BUILDING: 6011
WORK AREA: PBS

UOM: EA
LOT SIZE: 99
REJECT NO: 99
CAR/FRR:

NCR DATE: 05/30/91
DISPOSITION DATE: 12/20/91
CLOSE DATE: 06/01/92
DPRO COMMENTS: YES

PO:
VENDOR NO: 000000
VEND NAME:
VEND DOC NO:

INSPECTOR	ROBERT PICKERING	06/03/91
VALIDATION	NATE TOEWS	06/07/91
DISPOSITION	RAYMA RODRIGUEZ	12/20/91
CAUSE/CA (UTC)	RAY FRANKLIN	06/06/91
CAUSE/CA (VEN)	N/A	
QUAL DES ENGR	D.P. MCMAHON	12/23/91
CUSTOMER	JOHN MARTINEZ	12/23/91
CUSTOMER		
GOVT REP	RAYMOND CORREA	01/02/92
MFG ENG REWORK	MARY DELANEY	01/07/92
INSP ACCEPT	GERALDINE BARNES	06/01/92

NCR NARRATIVE

S/N ARE AS NOTED; 5465 THRU 5478, 5540 THRU 5551, 5554 THRU 5566, 5568 THRU 5574, 5576 THRU 5580, 5582 THRU 5599, 5625, 5627, 5629, 5630, 5633, 5635, 5641, 5661, 5663, 5668, 5674, 5678, 5679, 5696, 5697, 5136, 5152, 5328, 5340, 5357, 5372, 5382, 5401, 5409, 5460 THRU 5464, 6537. SJS 6-7-91 THIS NCR PREVIOUSLY APPROVED REPAIR OF CAD PLATE BY MRB NET 1-2-92

ITEM INFORMATION

ITEM:	OPER NO:	AFF QTY:	SERIAL NO:	DWG SPEC:	DEFECT CODE:	RESP ORGN:	OCC/REC:	DISP CODE:	DISP QTY
01	3	99	N/A	4-5/C	250 34	21833	000	RWK	99

DISCREPANCY & DISPOSITION

ITEM: 01

DISCREPANCY DESCRIPTION:
SURFACE PLATING MARRED BY SCRATCHES TO 0.002 DEEP, WHEN CAD FINISH ON AREA SHOULD BE 100% PER NOTE 4, ECO 37475.

DISPOSITION DESCRIPTION:
REWORK TO PRINT. APPROVED OUTSIDE VENDOR TO STRIP AND RE-PLATE THE ENTIRE SURFACE OF EACH PART IN ACCORDANCE WITH QQ-P-416, TYPE II, CLASS 2.
RATIONALE: THE REWORK TO PRINT WILL RETURN THE PARTS TO THE DRAWING REQUIREMENTS.

CAUSE & CORRECTIVE ACTION

ITEM:	CAUSE CODE:	CAUSE NARRATIVE:	CA CODE:	CORRECTIVE ACTION NARRATIVE:
01	40	CAR GENERATED TO INVESTIGATE AND DETERMINE CAUSE.	40	CAR #04434 EXPECTED COMPLETION DATE 6/7/91.

NCR: D11927 PLANT: COY DISC CAT: MT REF NO: N/A PR/MRB: MRB WC/OB: REPORT DATE: 09/01/93 P, 1

DISC P/N: B12003-09-01
DISC P/NAME: BSM NOZZLE QUAL
MFG PART NO: N/A
MFG PART NM: N/A
MFG SER NO: N/A
PLAN REL: MFGA96732
PROJECT NO: 5597
BUILDING: 0020
WORK AREA: PBS

UOM: EA
LOT SIZE: 1
REJECT NO: 1
CAR/FRR:

NCR DATE: 08/04/93
DISPOSITION DATE: 08/20/93
CLOSE DATE: 08/27/93
DPRO COMMENTS: NO

PO:
VENDOR NO: 000000
VEND NAME:
VEND DOC NO: N/A

INSPECTOR	ADRIAN RANDLES	
VALIDATION	CAROL DANIELS	08/04/93
DISPOSITION	FREDERICK PAYNE	08/04/93
CAUSE/CA (UTC)	MARY DELANEY	08/20/93
CAUSE/CA (VEN)	N/A	08/20/93
QUAL DES ENGR	MYRNA GARCIA	
CUSTOMER	PAUL LUNDY	08/20/93
CUSTOMER		08/27/93
GOVT REP	-N/A-	
MFG ENG REWORK	N/A	08/27/93
PURCH BUYER	N/A	08/27/93
INSP ACCEPT	MARK RADOVIC	08/27/93
		08/27/93

NCR NARRATIVE

SEE ATTACHED INTERIM DISPOSITION.MGG 7/29/93
INTERIM DISPOSITION #2. CD 7/30/93
INTERIM DISPOSITION #3 (CP) CD 8/4/93
SEE INTERIM DISPOSITION #4 - MK 8/17/93
SEE VMRR 006185 FOR DISPOSITION AUTHORITY. MK 8/20/93
SEE ATTACHED INTERIM DISPOSITION # 5 TO CONTINUE PROCESSING.MGG 8/23/93
VMRR APPROVED. CD 8/27/93

ITEM INFORMATION

ITEM:	OPER NO:	AFF QTY:	SERIAL NO:	DWG SPEC:	DEFECT CODE:	RESP ORGN:	OCC/REC:	DISP CODE:	DISP QTY
01	MAT0030	1	W0442	SE2073 3.3.1.2	510 14	21100	0	A	1
02	MAT0030	1	W0442	SE2073 3.3.10	335 58	21100	0	A	1
03	MAT0030	1	W0442	SE2073 3.2.2	335 29	21100	0	A	1
04	MAT0030	1	W0442	B12003/NOTE 47	125 12	21100	0	A	1

DISCREPANCY & DISPOSITION

ITEM: DISCREPANCY DESCRIPTION:

01 S/B:ALL SURFACE PREPARATIONS,ADHESIVE APPLICATIONS ACTIVITIE S SHALL BE PERFORMED IN A DESIGNATED BOND ROOM. IS:THE INSULATION WAS NOT BONDED INSIDE BONDING ROOM.

DISPOSITION DESCRIPTION:

USE-AS-IS. RISPW UNAFFECTED. THE ACCEPTABLE RESULTS OF THE TESTING AND INSPECTIONS PERFORMED IN ACCORDANCE WITH INTERIM DISPOSITIONS #1-4 SHOW THE INSULATOR-TO-CLOSURE BOND IS ACCEPTABLE. THE BOND TEST PANEL WHICH WAS CO-PROCESSED WITH THE DELTA QUALIFICATION AFT CLOSURES (CONT.)

02 S/B:VACUUM SHALL BE HELD ON CLOSURE INSULATOR FOR MIN. OF 12HRS. PRIOR TO BEGINNING OF CURE CYCLE.AFTER HOLD THE PART MAY NOT BE WITHOUT VACUUM MORE THAN 2HRS.ALL PARTS SHALL BE

EXHIBITED ACCEPTABLE RESULTS OF 89 PLI WHICH ARE FAR IN EXCESS OF THE MINIMUM REQUIREMENT OF 25 PLI. IN ADDITIO THE FAILURE MODE OF THE PANEL WAS COHESIVE IN THE RUBBER. THIS MEANS THE BOND STRENGTH IS GREATER THAN THE RUBBER STRENGTH WHICH SHOWS THE EXCELLENT QUALITY OF THE BOND. THE ULTRASONIC AND TAP INSPECTION SHOWED NO UNBONDS WHICH CONFIRMS THE BOND QUALITY. TOGETHER, THE ACCEPTABLE AND EXCELLENT RESULTS OF THE CO-PROCESSED PEEL PANEL, ULTRASONIC INSPECTION AND TAP INSPECTION SHOWS THAT THE BOND PROCESS NOT BEING PERFORMED IN A DESIGNATED BOND ROOM HAD NO EFFECT ON THE BOND QUALITY.
USE-AS-IS. RISPW UNAFFECTED. SEE ITEM 1 FOR RATIONALE.

HELD UNDER VACUUM OF 22 INCHES. OF MERCURY DURING VACUUM HOL
D.IS:CHART HAS ILLEGABLE READINGS FOR APPROX.5HRS.13MIN

03 S/B:NON SILICONE TAPES SHALL USED.
IS:TAPES USED ARE NOT CERTIFIED FOR SILICONE CONTENT.

USE-AS-IS. RISPW UNAFFECTED. THE INNER AND OUTER INSULATOR BOND EDGES WERE INSPECTED IN ACCORDANCE WITH DRAWING REQUIREMENTS. THE BONDLINE CONDITION WAS ACCEPTABLE WITH NO CONDITIONS REQUIRING REWORK WITH ADHESIVE. THE INSULATOR EDGES ARE IMMEDIATELY ADJACENT TO THE AREAS THAT (-->) ARE MASKED WITH TAPE DURING PROCESSING. THE ACCEPTABLE EDGE BOND CONDITION DEMONSTRATES THAT THE USE OF NON-CERTIFIED TAPES DID NOT ADVERSELY AFFECT THE BOND.

04 S/B:ULTRASONIC INSPECTION OF BONDING AREA.(SEE EXPANSION)
IS:NDT INSPECTION OF INSULATOR BOND AREA WAS PERFORMED.
NO UNBONDS NOTED IN AREAS INSPECTED.ONE AREA,FROM 210DEG TO 150DEG,WHERE NDT INSPECTION CANNOT BE PERFORM DO TO A CIRCUMFERENTIAL SURFACE RIDGE UP TO 0.1"WIDE,X 0.06"HIGH ON INSULATOR SURFACE.

OTHER. RISPW UNAFFECTED. THE RAISED MATERIAL WAS REMOVED IN ACCORDANCE WITH INTERIM DISPOSITION #4 AND THE ULTRASONIC INSPECTION PERFORMED PER APPROVED REPAIR PLANNING. THE REMOVAL WAS ACCOMPLISHED SUCCESSFULLY WITH NO GOUGES OR DEPRESSIONS CREATED IN THE INSULATOR SURFACE. THE (CONT) ULTRASONIC INSPECTION WAS ACCEPTABLE WITH NO UNBONDS NOTED.

CAUSE & CORRECTIVE ACTION

ITEM:	CAUSE CODE:	CAUSE NARRATIVE:	CA CODE:	CORRECTIVE ACTION NARRATIVE:
01	40	SEE USBI CAR #659.	40	SEE USBI CAR #659.
02	11	DURING VACUUM HOLD, VACUUM CHART BECAME JAMMED FOR A PEROID OF TIME. NO OVEN WATCH WAS AVAILABLE.	11	VACUUM RECORDER WAS CLEANED AND PUT BACK INTO SERVICE. DATA BEFORE AND AFTER INDICATED VACUUM WAS HELD. OVEN WATCH WILL BE SCHEDULED DURING AUTOCLAVE OPERATION TO VERIFY PRINTER IS RECORDING.
03	40	SEE USBI CAR #659.	40	SEE USBI CAR #659.
04	11	THE RIDGE IN THE AFT CLOSURE INSULATION OF THE DELTA QUALIFICATION ASSEMBLIES WAS CAUSED BY AN EXCESSIVE AMOUNT OF BLEEDER CLOTH WHICH WAS PLACED IN THE VACUUM BAG OVER THE INSULATOR FORMING DONUT (REF.SK-MFP081993-1). AS CAN BE SEEN IN THE SKETCH, THE EXCESSIVE BLEEDER CLOTH WAS UNABLE TO PROPERLY PULL DOWN INTO THE CORNER WHICH LEFT A SPACE. THIS SPACE SUBSEQUENTLY FILLED WITH RUBBER UNDER HEAT AND PRESSURE OF THE AUTOCLAVE CURE WHICH FORMED A RIDGE IN THE INSULATION.	11	THE CORRECTIVE WILL BE TO CONTROL THE AMOUNT OF BLEEDER CLOTH INSTALLED IN THE VACUUM BAG. ONLY TWO LAYERS OF NYLON RELEASE CLOTH WILL BE USED OVER THE FORMING DONUT. THIS METHOD OF BAGGING IS SIMILAR TO THAT USED ON THE DEMONSTRATION UNITS. THE DEMONSTRATION UNITS WERE COMPLETELY ACCESSIBLE TO NDT INSPECTION IN THE AREA WHERE THE RIDGE FORMED ON THE DELTA QUALIFICATION UNITS. THIS CORRECTIVE ACTION WILL BE CONFIRMED BY THE FABRICATION OF ONE ADDITIONAL DEMONSTRATION UNIT. THE NOZZLE ASSEMBLY PRODUCTION PLANNING FOR LOT ABA WILL THEN BE REVISED TO CONTROL THE AMOUNT OF BLEEDER CLOTH INSTALLED AND A PICTORIAL DEPICTION OF THE PROPER BAGGING TECHNIQUE WILL BE ADDED. TRAINING SESSIONS WILL BE CONDUCTED AND DOCUMENTED TO INSURE OPERATORS WHO PERFORM INSULATION VULCANIZATION PROCESSESS ARE KNOWLEDGEABLE REGARDING PLANNING AND PROCESS REQUIREMENTS. THE NOZZLE ASSEMBLY DRAWINGS WILL BE REVISED TO SPECIFY THE ALLOWED POST-VULCANIZATION CONTOUR OF THE INSULATOR.

TECHNOLOGIES
USBI

VENDOR MATERIAL REVIEW REPORT

VMRR NO 006185 PAGE 1 OF

NAME NOZZLE ASSEMBLY | 2 PART/SPEC NO B12003-09 | 3 DASH NO 01 | 4 REV #1 | 5 ECO NO 5542-00222 | 6 USBI SERIAL/LOT NO WO 442 | 7 LOT SIZE 1 | 8 QTY ACC 0 | 9 QTY REJ 1

11 PO NO 018333 | 12 ITEM N/A | 13 WOR NO 4052-501-0003 | 14 VENDOR NAME AND ADDRESS UTC/CSD PO BOX 49028 SAN JOSE, CA 95161-9028 | 15 VENDOR ID NO 30120

17 ITEM NO	18 QTY	19 DWG ZONE SPEC PAR	20 DWG/SPEC REQ (INCLUDE TOLERANCE)	21 NONCONFORMANCE/DESCRIPTION OF TROUBLE (ACTUAL READING OR CONDITION)
1	1	3.3.1.2 SE2073		S/B: ALL SURFACE PREPARATIONS, PRIMER AND ADHESIVE
		BONDING REV. BASIC		APPLICATIONS, MATING OF INSULATOR TO CLOSURE AND
		ROOM		TEMPORARY STORAGE ACTIVITIES SHALL BE PERFORMED IN A
				DESIGNATED BOND ROOM.
				IS: THE INSULATOR TO CLOSURE PREPARATIONS, PRIMER AND
				ADHESIVE APPLICATIONS, MATING OF INSULATOR TO CLOSURE
				WORK NOT PERFORMED INSIDE THE BONDING ROOM.
				REF: CSD NCR D11927

22 REPETITIVE NONCONFORMANCE ☐ NO ☒ YES 1 TIMES IN 1 MONTH VMRR NO 006184

OF NONCONFORMANCE AND CORRECTIVE ACTION TAKEN TO PREVENT RECURRENCE

SEE ATTACHMENT I FOR CAUSE AND CORRECTIVE ACTION FOR ITEM Nos. 1 & 3.
REFERENCE USBI CAR 659.
SEE ATTACHMENT II FOR CAUSE AND CORRECTIVE ACTION FOR ITEM No. 4
SEE ATTACHMENT III FOR CAUSE AND CORRECTIVE ACTION FOR ITEM 2 AS REPORTED ON NCR D11927

24 FAILURE REPORT ☒ NO ☐ YES REPORT NO _____

25 EFFECTIVITY OF CORRECTIVE ACTION SN OR DATE LOT ACA

26 CONFIRMING TWX ☒ NO ☐ YES TWX NO _____

27 [redacted] DCMC DATE 8/20/93

28 QUALITY CONTROL SUPERVISION M. Kubik DATE 8/20/93

28 USBI REPRESENTATIVE DATE 8-20-93

SPACE BELOW RESERVED FOR USBI

☐ PRELIMINARY REVIEW ☒ MATERIAL REVIEW BOARD

30 ITEM NO	31 QTY	32 ORGN RESP	33 DISP CODE	34 DISPOSITION INSTRUCTIONS	35 QC ACCEPT
1,2,3	1	V	A	USE AS IS. SEE PAGE 5 FOR RATIONALE.	USBI 93 SOURCE INSP 9-3-93
4	1	V	B	REWORK TO PRINT. SEE PAGE 5 FOR DIRECTION.	USBI 93 SOURCE INSP 9-3-93

ONAL CORRECTIVE ACTION REQUIREMENTS IF ANY

37 QUALITY ENGINEER Edward J. Brierley DATE 8-26-93

38 ENGINEERING REPRESENTATIVE Lorence K. Burke DATE 8/25/93

39 CUSTOMER APPROVAL John T. A. Reiss DCMC 27 DATE 27 Aug 93

USB 1453 (88/01)

UNITED TECHNOLOGIES USBI

VMRR (Continuation Sheet)

1. VMRR No. 006185

Page 2 of 5232

Date	3. Part Name	4. Part or Spec No.	5. Dash No.	6. Rev	7. E.C.O. No.
6-19-93	EWD NOZZLE ASSEMBLY QUALZ	B12003-09 and 01		A1	5596-00222

8. Item No.	9. Qty	10. Drawing Zone Spec. Para	11. Drawing and Spec. Req (to include tolerance)	12. Nonconformance and Description of Trouble (actual reading or condition)
2	1	3.3.12	SE2073	S/B: VACUUM SHALL BE HELD ON CLOSURE INSULATORS
		VACUUM	REV. BASIC	FOR A MINIMUM OF 12 HOURS PRIOR TO BEGINNING OF
		BAGGING		CURE CYCLE. AFTER HOLD, THE PART MAY NOT BE
				WITHOUT VACUUM MORE THAN TWO HOURS. ALL PARTS SHALL
				BE HELD UNDER A MINIMUM VACUUM OF 22 INCHES.
				IS: VACUUM RECORDER CHART HAS ILLEGIBLE VACUUM
				READINGS FOR APPROXIMATELY 5 HOURS 15 MINUTES.

Add Graphs – Illustrations etc. As Required

13. ~~Quality Control Inspector~~	Date	14. Quality Control Supervisor	Date	15. USBI Representative	Date
Nadine Cobley DCMC	8/20/93	M Frank	8/20/93		

USBI To Complete Below

16. Item No.	17. Qty	18. Org Resp	19. Disposition Instructions ☐ Preliminary Review ☐ Material Review Board	20. Disp Code	21. QC Accept

22. Quality Engineer	Date	23. Engineering Representative	Date	24. Customer Approval	Date
Edward J. Buckley	8-26-93	Vernon L. Burke	8/25/93	John M. Reese DCMC	27 Aug 93

USR 14538 (01 mo)

GAC

UNITED TECHNOLOGIES USBI

VMRR (Continuation Sheet)

1. VMRR No. 006185

Page 3 of 503

ate	3. Part Name	4. Part or Spec No.	5. Dash No.	6. Rev	7. E.C.O. No.
5-1993	NOZZLE ASSEMBLY AND, QUAL T	B12003-09	01	* 1	5594 - 002337

8. Item No.	9. Qty	10. Drawing Zone Spec. Para	11. Drawing and Spec. Req (to include tolerance)	12. Nonconformance and Description of Trouble (actual reading or condition)
3	1	3.2.2	SE 2073	S/S: NON-SILICONE TAPES SHALL BE USED.
		MASKING	REV. BASIC	I.S: TAPES USED FOR MASKING ARE NOT CERTIFIED
		TAPES		FOR SILICONE CONTENT

Add Graphs – Illustrations etc. As Required

13. ~~Quality Control Inspector~~	Date	14. Quality Control Supervisor	Date	15. USBI Representative	Date
Nadine Calley DCMC	8/20/93		8/20/93		

USBI To Complete Below

16. Item No.	17. Qty	18. Org Resp	19. Disposition Instructions ☐ Preliminary Review ☐ Material Review Board	20. Disp Code	21. QC Accept

22. Quality Engineer	Date	23. Engineering Representative	Date	24. Customer Approval	Date
Edward J. Bradley	8-26-93	Vincent L. Burke	8/25/93	John M. Reus DCMC	27 Aug 93

USB 14538 (94 mo)

DAE

UNITED TECHNOLOGIES USBI

VMRR (Continuation Sheet)

1. VMRR No. 006185

Page 4 of 8230

3. Part Name	4. Part or Spec No.	5. Dash No.	6. Rev	7. E.C.O. No.
NOZZLE ASSEMBLY FWD, DUAL 2	B12003-09	01	* 1	5591-00222

8. Item No.	9. Qty	10. Drawing Zone Spec. Para	11. Drawing and Spec. Req (to include tolerance)	12. Nonconformance and Description of Trouble (actual reading or condition)
4	1	FLAG NOTE 4	B12003-XX-XX	S/B: ULTRASONIC INSP OF THE BOND INTERFACE OF INSULATION, AFT CLOSURE IS: NDT INSPECTION OF INSULATOR BOND AREA WAS PERFORMED. NO VOIDS NOTED IN AREAS INSPECTED. ONE AREA FROM 210° TO 150° WHERE NDT INSPECTION CANNOT BE PERFORMED DUE TO A CIRCUMFERENTIAL RIDGE UP TO 0.1" WIDE X 0.06" HIGH ON INSULATOR SURFACE.

Add Graphs – Illustrations etc. As Required

13. ~~Quality Control Inspector~~ DCMC	Date	14. Quality Control Supervisor	Date	15. USBI Representative	Date
Nadine Cadley	8/20/93	M. R. Gaunt	8/20/93		

USBI To Complete Below

16. Item No.	17. Qty	18. Org Resp	19. Disposition Instructions ☐ Preliminary Review ☐ Material Review Board	20. Disp Code	21. QC Accept

22. Quality Engineer	Date	23. Engineering Representative	Date	24. Customer Approval	Date
Edward J. Buckley	8-26-93	Vincent K. Burke	8/25/93	John M. Reis DCMC	Aug 93

USB 1453A (91/09)

Item: 1, Qty: 1

Use-as-is for qualification testing. The requirement for performing adhesive bonding operation inside a bonding room is intended to insure that no contamination degrades the mechanical bond. The peel test samples, which were co-processed in the same area as the closure insulators, yielded acceptable bond strength values well above the 25 pli minimum requirement. These test samples provide confidence that the insulator to closure vulcanized bond has adequate strength. (ATTACHMEN

Item: 2, Qty: 1

Use-as-is for qualification testing. The 12 hour vacuum hold period is a process control requirement to insure that entrapped air between the closure and the insulator is removed. Entrapped air could potentially cause an unbond in the interface. The post-vulcanization inspection of the bondline (ultrasonic and tap test) verified that there are no unbonds between the insulator and closure. Therefore there is no hardware discrepancy.

Item: 3, Qty: 1

Use-as-is for qualification testing. The requirement for non-silicone tapes is intended to preclude silicone contamination of the adhesive bond. The tape used was applied to the threads of the closure which is not part of the bond area. Adequate bonding was achieved as shown by the closure/insulator edge bond inspection. The use of the silicone tape will provide for qualification of a more worse case condition that what will exist in flight motors.

Item: 4, Qty: 1

Rework to print by removing the raised area and re-inspecting via ultrasonic inspection and tap test. Use Non-Conformance Rework/Repair Planning for NCR D11923 ~~(attached).~~

(ATTACHMENT V)

George L. Burke 8/25/93

Donald Sweval 8-20-93
USBI Engineering

Edward J. Buckley 8-26-93
USBI Quality

John M Reese
DCMC QE 27 Aug 93

USBI 93 SOURCE INSP

9-3-93

RESPONSE TO USBI CAR 659

CAUSE:

The documented discrepancy is a first time occurrence. Insulated closures P/N B12003-09-01, S/N W0442 (FWD), Release Number MFGA 96732, and P/N B12003-10-01, S/N I0705, (AFT), Release Number MFGA 96733, were being processed per Material Acceptance Traveler (MAT) operation 0030 to bond rubber insulator to metal closure per SE 2073 as part of the Delta Qualification Program. Peel 180° panel was processed in the same environment as the two closures. Paragraph 3.3.1.2 requires surface preparation, priming, adhesive applications, mating of parts and the temporary storage activities to be completed in a "designated" bonding room. The BSM designated bonding room was not utilized as required for the two referenced closure assembly bonding activities prior to vacuum hold and autoclave cure.

The masking tape employed as part of bonding activities contained no identification that allowed verification of a "Silicone-Free" material, violating paragraph 3.2.2 of specification SE 2073. The masking tape used in the two Delta qualification units was the same as used for the demonstration units and is CSD #80031. No part number identification was on the roll of tape. Verification of the support material is obtained via part master description. No certification of the silicone content of the tape was available at the time of operational use. Verification that the tape is "Silicone-Free" has been obtained (see attached) from the manufacturer.

The requirement to perform specific tasks within the designated bond room and verification of "Silicone-Free" masking tape was overlooked by the CSD engineer and operators (Quality inspection is not required by the approved planning to witness the operation in question) present at the time the operation was proceeding. The inspector does have mandatories within the planning package, however was performing other duties in a separate location on site while the bonding operation was being performed. PI 07.2.048.0 calls out the bond room requirement (see attached) under Item 10 of the prerequisites. Demonstration units were bonded in the same general area as the two Delta qualification units. The operation occurred on a Sunday while very little other activity was underway within the station.

CORRECTIVE ACTION:

Nonconformance reports, D11923 and D11927, were written to document the discrepancies described above and allow for Material Review Board (MRB) disposition. The following actions are being taken to correct the errors and prevent re-occurrence.

1) Process Instruction (PI) 07.2.048.0 has been revised per Planning Change Sheet (PCS) No. 040487 (see attached) to identify by CSD part number on the support materials list and within the body of the instruction at the masking operations the "Silicone-Free" tape that was used for the two Delta qualification units and will be for all future production parts. A second "Silicon-Free" masking tape has been called out as a back-up.

RESPONSE TO USBI CAR 659
(Continued)

2) Data Acceptance Record (DAR) items have been added per PCS No. 040487 to require stamped verification that the designated bond room and masking tape(s) have been used to process the hardware.

3) Identification tags with CSD Part Number, Lot Number, and Quality Inspection Stamp will be required on the appropriate rolls of masking tape.

4) Manufacturer's Certificate of Conformance have been added to the Receiving Inspection Packages (RIP) to document the masking tape used for the two Delta qualification units and future production units is "Silicone-Free".

5) A storage area within the BSM adhesive bonding room to store the selected masking tapes has been established.

6) Part master descriptions for CSD part numbers have been updated to require a certification of "Silicone-Free" material for any future orders.

7) A training session to detail the BSM insulated closure bonding process, with emphasis on the bond room and tape requirements, has been completed (see attached attendance sheet). Operators will complete a formal training session prior to performing bonding operations.

8) Review of the igniter and loaded motor assembly and paperwork shall be conducted prior to commencing bonding operations to ensure compliance to design requirements. The review shall be completed by CSD Quality, Manufacturing, and Design representatives. PCS's shall be issued per CSD Standard Procedure 50.23.12, to incorporate any required document changes.

Attachment II
VMRR 006135

CAUSE:

The ridge in the aft closure insulation of the Delta Qualification nozzle assemblies was caused by an excessive amount of bleeder cloth which was placed in the vacuum bag over the insulator forming donut (ref. SK-FMP081993-1). As can be seen in the sketch, the excessive bleeder cloth was unable to properly pull down into the corner which left a space. This space subsequently filled with rubber under the heat and pressure of the autoclave cure which formed a ridge in the insulation.

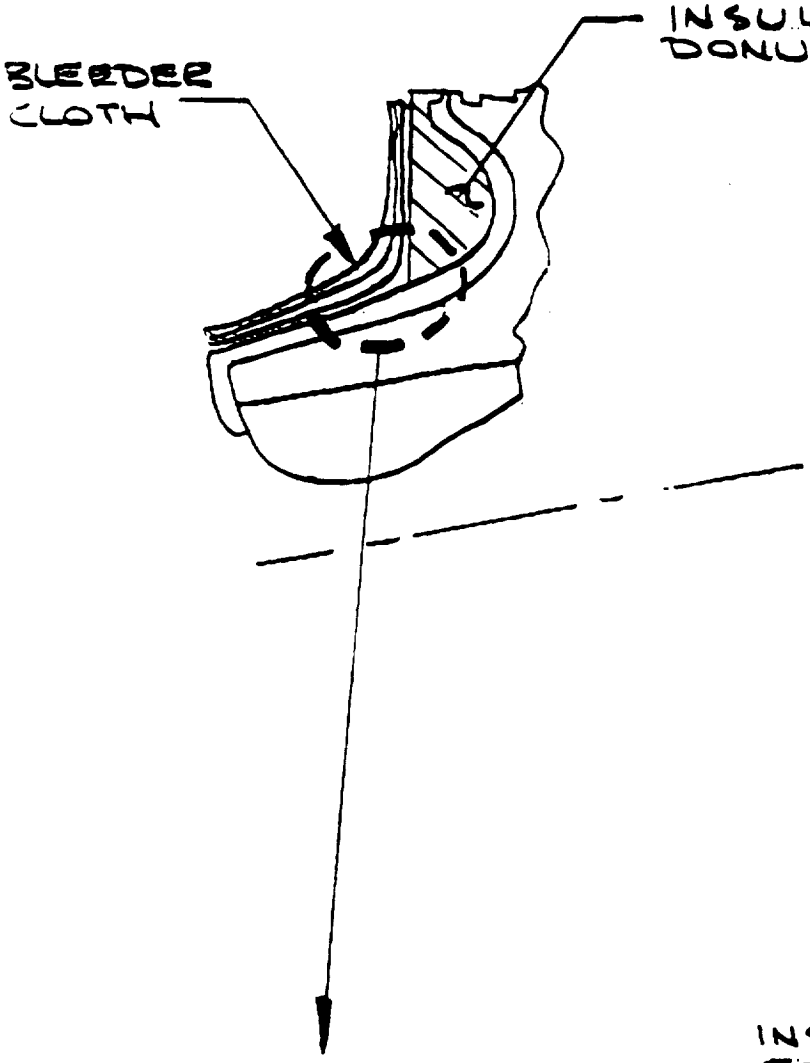
CORRECTIVE ACTION:

The corrective action will be to control the amount of bleeder cloth installed in the vacuum bag. Only two layers of nylon release cloth will be used over the forming donut. This method of bagging is similar to that used on the demonstration units. The demonstration units were completely accessible to NDT inspection in the area where the ridge formed on the Delta Qualification units. This corrective action will be confirmed by the fabrication of one additional demonstration unit. The nozzle assembly production planning for lot ABA will then be revised to control the amount of bleeder cloth installed and a pictorial depiction of the proper bagging technique will be added. Training sessions will be conducted and documented to insure operators who perform insulation vulcanization processes are knowledgeable regarding planning and process requirements. The nozzle assembly drawings will be revised

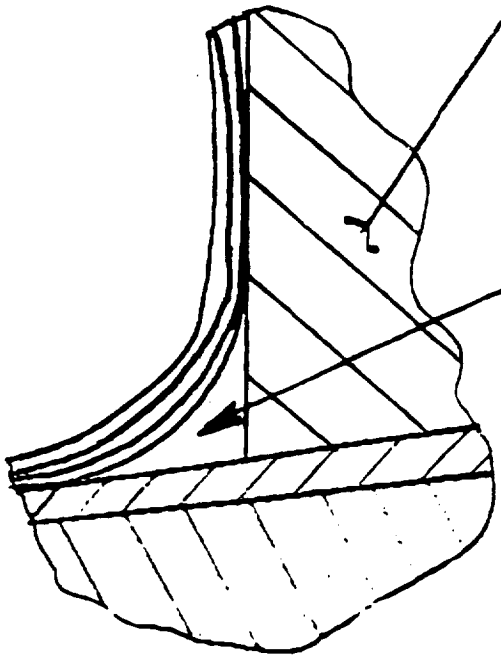
ATTACHMENT II
VMAA 006185

to specify the allowed post-vulcanization contour of the insulator.

CROSS SECTION OF NOZZLE ASSEMBLY W/ FORMING DONUT & BLEEDER CLOTH



ATTACHMENT II
VMRR 026185



SK-FMP081993-1

NCR: D11927 PLANT: COY DISC CAT: NT REF NO: N/A PR/MRB: MRB VC/OB: REPORT DATE: 08/26/93 PAGE: 1

DISC P/N: B12003-09-01
DISC P/NAME: BSN NOZZLE QUAL
MFG PART NO: N/A
MFG PART NR: N/A
MFG SER NO: N/A
PLAN REL: MFGA96732
PROJECT NO: 5597
BUILDING: 0020
WORK AREA: PBS

UOM: EA
LOT SIZE: 1
REJECT NO: 1
CAR/FRR:

NCR DATE: 08/04/93
DISPOSITION DATE: 08/20/93
CLOSE DATE:
DPRO COMMENTS: NO

PO:
VENDOR NO: 000000
VEND NAME:
VEND DOC NO: N/A

INSPECTOR	ADRIAN RANDLES	08/04/93
VALIDATION	CAROL DANIELS	08/04/93
DISPOSITION	FREDERICK PAYNE	08/20/93
CAUSE/CA (UTC)	MARY DELANEY	08/20/93
CAUSE/CA (VEN)	N/A	
QUAL DES ENGR	MYRNA GARCIA	08/20/93
CUSTOMER		
CUSTOMER		
GOVT REP		

NCR NARRATIVE

SEE ATTACHED INTERIM DISPOSITION.MGG 7/29/93
INTERIM DISPOSITION #2. CD 7/30/93
INTERIM DISPOSITION #3 (CP) CD 8/4/93
SEE INTERIM DISPOSITION #4 - MK 8/17/93
SEE VMRR 006185 FOR DISPOSITION AUTHORITY. MK 8/20/93
SEE ATTACHED INTERIM DISPOSITION # 5 TO CONTINUE PROCESSING.MGG 8/23/93

ITEM INFORMATION

ITEM:	OPER NO:	AFF QTY:	SERIAL NO:	DWG SPEC:	DEFECT CODE:	RESP ORGN:	OCC/REC:	DISP CODE:	DISP QTY
01	MAT0030	1	W0642	SE2073 3.3.1.2	510 14	21100	0	A	1
02	MAT0030	1	W0642	SE2073 3.3.10	335 58	21100	0	A	1
03	MAT0030	1	W0442	SE2073 3.2.2	335 29	21100	0	A	1
04	MAT0030	1	W0442	B12003/NOTE 47	125 12	21100	0	0	1

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DISCREPANCY & DISPOSITION

ITEM: DISCREPANCY DESCRIPTION:

01 S/B:ALL SURFACE PREPARATIONS,ADHESIVE APPLICATIONS ACTIVITIE S SHALL BE PERFORMED IN A DESIGNATED BOND ROOM.
IS:THE INSULATION WAS NOT BONDED INSIDE BONDING ROOM.

DISPOSITION DESCRIPTION:

USE-AS-IS. RISPW UNAFFECTED. THE ACCEPTABLE RESULTS OF THE TESTING AND INSPECTIONS PERFORMED IN ACCORDANCE WITH INTERIM DISPOSITIONS #1-4 SHOW THE INSULATOR-TO-CLOSURE BOND IS ACCEPTABLE. THE BOND TEST PANEL WHICH WAS CO-PROCESSED WITH THE DELTA QUALIFICATION AFT CLOSURES (CONT.)

02 S/B:VACUUM SHALL BE HELD ON CLOSURE INSULATOR FOR MIN. OF 12HRS. PRIOR TO BEGINNING OF CURE CYCLE.AFTER HOLD TIME PART MAY NOT BE WITHOUT VACUUM MORE THAN 2HRS.ALL PARTS SHALL BE HELD UNDER VACUUM OF 22 INCHES. OF MERCURY DURING VACUUM HOL D.IS:CHART HAS ILLEGABLE READINGS FOR APPROX.5HRS.13MIN

EXHIBITED ACCEPTABLE RESULTS OF 89 PLI WHICH ARE FAR IN EXCESS OF THE MINIMUM REQUIREMENT OF 25 PLI. IN ADDITION, THE FAILURE MODE OF THE PANEL WAS COHESIVE IN THE RUBBER. THIS MEANS THE BOND STRENGTH IS GREATER THAN THE RUBBER STRENGTH WHICH SHOWS THE EXCELLENT QUALITY OF THE BOND. THE ULTRASONIC AND TAP INSPECTION SHOWED NO UNBONDS WHICH CONFIRMS THE BOND QUALITY. TOGETHER, THE ACCEPTABLE AND EXCELLENT RESULTS OF THE CO-PROCESSED PEEL PANEL, ULTRASONIC INSPECTION AND TAP INSPECTION SHOWS THAT THE BOND PROCESS NOT BEING PERFORMED IN A DESIGNATED BOND ROOM HAD NO EFFECT ON THE BOND QUALITY.
USE-AS-IS. RISPW UNAFFECTED. SEE ITEM 1 FOR RATIONALE.

03 S/B:NON SILICONE TAPES SHALL USED.

USE-AS-IS. RISPW UNAFFECTED. THE INNER AND OUTER INSULATOR

pg 11 of 23
VMRR 006185
Attachment 11

IS:TAPES USED ARE NOT CERTIFIED FOR SILICONE CONTENT.

04 S/B:ULTRASONIC INSPECTION OF BONDING AREA.(SEE EXPANSION)
IS:NDT INSPECTION OF INSULATOR BOND AREA WAS PERFORMED.
NO UNBONDS NOTED IN AREAS INSPECTED.ONE AREA,FROM 210DEG TO 150DEG,WHERE NDT INSPECTION CANNOT BE PERFORM DO TO A CIRCUMFERENTIAL SURFACE RIDGE UP TO 0.1"WIDE,X 0.06"HIGH ON INSULATOR SURFACE.

BOND EDGES WERE INSPECTED IN ACCORDANCE WITH DRAWING REQUIREMENTS. THE BONDLINE CONDITION WAS ACCEPTABLE WITH NO CONDITIONS REQUIRING REWORK WITH ADHESIVE. THE INSULATOR EDGES ARE IMMEDIATELY ADJACENT TO THE AREAS THAT (-->) ARE MASKED WITH TAPE DURING PROCESSING. THE ACCEPTABLE EDGE BOND CONDITION DEMONSTRATES THAT THE USE OF NON-CERTIFIED TAPES DID NOT ADVERSELY AFFECT THE BOND. OTHER. RISPU UNAFFECTED. THE RAISED MATERIAL WAS REMOVED IN ACCORDANCE WITH INTERIM DISPOSITION #4 AND THE ULTRASONIC INSPECTION PERFORMED PER APPROVED REPAIR PLANNING. THE REMOVAL WAS ACCOMPLISHED SUCCESSFULLY WITH NO GOUGES OR DEPRESSIONS CREATED IN THE INSULATOR SURFACE. THE (CONT) ULTRASONIC INSPECTION WAS ACCEPTABLE WITH NO UNBONDS NOTED.

ITEM:	CAUSE CODE:	CAUSE NARRATIVE:	CA CODE:	CORRECTIVE ACTION NARRATIVE:
01	40	SEE USBI CAR #659.	40	SEE USBI CAR #659.
02	11	DURING VACUUM HOLD, VACUUM CHART BECAME JAMMED FOR A PERIOD OF TIME. NO OVEN WATCH WAS AVAILABLE.	11	VACUUM RECORDER WAS CLEANED AND PUT BACK INTO SERVICE. DATA BEFORE AND AFTER INDICATED VACUUM WAS HELD.
03	40		40	OVEN WATCH WILL BE SCHEDULED DURING AUTOCLAVE OPERATION TO VERIFY PRINTER IS RECORDING.
04	11	SEE USBI CAR #659. THE RIDGE IN THE AFT CLOSURE INSULATION OF THE DELTA QUALIFICATION ASSEMBLIES WAS CAUSED BY AN EXCESSIVE AMOUNT OF BLEEDER CLOTH WHICH WAS PLACED IN THE VACUUM BAG OVER THE INSULATOR FORMING DONUT (REF.SK-MFP081993-1). AS CAN BE SEEN IN THE SKETCH. THE EXCESSIVE BLEEDER CLOTH WAS UNABLE TO PROPERLY PULL DOWN INTO THE CORNER WHICH LEFT A SPACE. THIS SPACE SUBSEQUENTLY FILLED WITH RUBBER UNDER HEAT AND PRESSURE OF THE AUTOCLAVE CURE WHICH FORMED A RIDGE IN THE INSULATION.	11	SEE USBI CAR #659. THE CORRECTIVE WILL BE TO CONTROL THE AMOUNT OF BLEEDER CLOTH INSTALLED IN THE VACUUM BAG. ONLY TWO LAYERS OF NYLON RELEASE CLOTH WILL BE USED OVER THE FORMING DONUT. THIS METHOD OF BAGGING IS SIMILAR TO THAT USED ON THE DEMONSTRATION UNITS. THE DEMONSTRATION UNITS WERE COMPLETELY ACCESSIBLE TO NDT INSPECTION IN THE AREA WHERE THE RIDGE FORMED ON THE DELTA QUALIFICATION UNITS. THIS CORRECTIVE ACTION WILL BE CONFIRMED BY THE FABRICATION OF ONE ADDITIONAL DEMONSTRATION UNIT. THE NOZZLE ASSEMBLY PRODUCTION PLANNING FOR LOT ABA WILL THEN BE REVISED TO CONTROL THE AMOUNT OF BLEEDER CLOTH INSTALLED AND A PICTORIAL DEPICTION OF THE PROPER BAGGING TECHNIQUE WILL BE ADDED. TRAINING SESSIONS WILL BE CONDUCTED AND DOCUMENTED TO INSURE OPERATORS WHO PERFORM INSULATION VULCANIZATION PROCESSESS ARE KNOWLEDGEABLE REGARDING PLANNING AND PROCESS REQUIREMENTS. THE NOZZLE ASSEMBLY DRAWINGS WILL BE REVISED TO SPECIFY THE ALLOWED POST-VULCANIZATION CONTOUR OF THE INSULATOR.

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UNITED TECHNOLOGIES CHEMICAL SYSTEMS

NCR Disposition
Continuation Sheet

12 DISCREPANT ITEM NAME	13 DISCREPANT ITEM P/N	28 ORIGINATOR	DATE	4 REF./NCR NO	5 PAGE OF
BSM Nozzle Qual	MB12003-09-01	J.M. Payne	7/29/93	D11927	31

35 ITEM	36 QTY	37 DISP CODE	38 ITEM DISPOSITION	39 OPERATIONS	40 QUALITY
			INTERIM DISPOSITION #1		
			Continue processing of peel test panel through testing in accordance with SE2073. Report results to MRB.		
			J.M. Payne 7/29/93 CSD Design Engr'g		
			Myron P. Lewis – CSD PDE 7/29/93		
			USBE's Quyen Le Le 7/30/93		
			CONCURRED WITH BY USBE/HSE ENGINEERING AND QUALITY ENGINEERING		
			DCMC-CSD-QA Clifford J. Stelzel 7-30-93		

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MB 13 of 23
VMKR2 00414
Attachment #1

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

NCR Disposition
Continuation Sheet

12 DISCREPANT ITEM NAME: BSM Nozzle Qual
13 DISCREPANT ITEM NO: B12003-09-01
28 ORIGINATOR: J. M. Payne
DATE: 7/31/93
4 REF NCR NO: D11927
5 PAGE: 4 OF 1

35 ITEM	36 QTY	37 DISP CODE	38 ITEM DISPOSITION	39 OPERATIONS	40 QUALITY

INTERIM DISPOSITION #2

Based on acceptable results of interim disposition #1, cohesive rubber failure and 89 PLI peel strength, proceed to edge bond inspection and ultrasonic testing. Report results to MRB.

James M. Payne 7/31/93 CSD Design Engr

Carol Daniels Per Telecon CSDQE 4:10PM 7/31/93

Note: Area of insulator which exhibits abrupt change in contour, "ridge", shall not be ultrasonic inspected at this time. The ridge area shall be ultrasonically inspected after removal of the ridge.

James M. Payne 7/31/93 CSD Design Engr

Carol Daniels Per Telecon CSDQE 4:15PM 7/31/93

(See attached UT. report for results.)

USBE: [signature] 7/31/93.

CONCURRED WITH BY USBE/MSV ENGINEERING AND QUALITY ENGINEERING.

DPRO: Nancy P. Cronin for Nadine Calvez / Telecon @ 1340 7/31/93

089

VMKR 00635
Enclosure III

TAP TEST EXAMINATION DATA SHEET

PAGE D

PART NAME	PART NUMBER/DRAWING/REV	PLANNING DOCUMENT #
BSM NOZZLE ASSEMBLY	B12003-09-01/ B12003-09-01/	NCR D 11927 INTERIM R 2
WORK INSTRUCTION — TECH #	**ACCEPT/REJECT CRITERIA**	**HAMMER SIZE**
60.12.9-590-001	PER PLANNING	.50 OZ
TYPE OF MATERIAL	**NCR #**	**PROJECT NO/WOR #**
RUBBER	NONE	5597/5597-986-0000

ITEM S/N	IDENTIFICATION DESCRIPTION/REMARKS	ACC	REJ
W0442	NO UNBONDS NOTED	*	*

SKETCH

* ACCEPTANCE DETERMINED BY CALCULATIONS AT DAR STEP D024.

INSPECTOR	LEVEL	DATE
Michael Peeler	II	7-31-93

Ultrasonic Report/ Calibration Sheet

Page 1 of 1

PART NAME: BSM NOZZLE ASSEMBLY	WORK ORDER NUMBER: 3597-96-0000
PART NUMBER: B12003-09-01	PLANNING DOCUMENT INFO. Release No.: NCR# D11927 INTERIM #2 / NCR No. (If applicable): NONE
Material: RUBBER/ALUM	Component Serial No.: N0442 / Project Name: BSM
Specification/Technique: SE1754/60.12.9-553	CALIBRATION CHECKS Initial: Time 1430
Quantity: Received 1 / Inspected 1 / Accepted * / Rejected *	Intermediate: Time —
	Final: Time 1530
Instrument/Serial Number: SOUK MKII Calibration Date: 9-16-93	INSTRUMENT SETTINGS
Transducer — Size/Frequency — Serial Number: .25"/10 MHZ/	Sweep C: ____ F: ____
Scanning Method: CONTACT	Delay C: P F R ____ F: ____
Test Blocks/Standards: STANDARD# K371	dB: W.1 Reject On Off
COUPLANT: ULTRAGEL II	Frequency: ____

EXAMINATION AREA	COMMENTS
100%	*ACCEPTANCE DETERMINED BY CALCULATIONS AT DAR STEP D024.
	UNABLE TO INSPECT CLOSURE FROM 210° TO 150°, 10° W/ BECAUSE OF RIDGE ON PART.
	NO UNBONDS NOTED.

Michael Peck (47 CS) — Inspector

II — Level

7-31-93 — Date

CSD 2795 (92/03)

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

NCR Disposition
Continuation Sheet

12 DISCREPANT ITEM NAME	13 DISCREPANT ITEM P/N	28 ORIGINATOR	DATE	4 REF NCR NO	5 PAGE OF
BSM NOZZLE QUAL	B12003-09-01	MARY DELANEY	8-3-93	D11927	7 1

35 ITEM	36 QTY	37 DISP CODE	38 ITEM DISPOSITION	39 OPER NUMBER	40 SHELF NO
1-4	1	Q	INTERIM DISPOSITION #3		
			CONTINUE PROCESSING THROUGH PROCESS INSTRUCTION		
			07.2.048 REV Q, OPERATION 11, STEP 050.		
			CSD ENG: Arden M. Edwards 8/4/93		
			CSD QUAL ENG: Carl Daniel 8/4/93		
			USBI: Paul Lundy 8/4/93		
			DCMO: Ray Cowan 5 Aug 93		

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PJ. 17 of 23
YMKR 0015
1-4 Boosters II

UNITED TECHNICAL CHEMICAL SYSTEMS

NCR Disposition
Continuation Sheet

12 DISCREPANT ITEM NAME	13 DISCREPANT ITEM P/N	28 ORIGINATOR	DATE	4 REF. NCR NO.	5 PAGE
BSM Nozzle Qual	B12003-09-01	Gabriel M. Payne	8/17/93	D11927	8 of

35 ITEM	36 QTY	37 DISP CODE	38 ITEM DISPOSITION	39 REMARKS	40 QUALITY
			Interim Disposition #4		
4	1		Continue processing by removing the raised material by abrasion until the 0.1 inch wide area is flush with the adjacent surfaces. The abraded area must be smooth and continuous. CSD Engineering and USBI shall witness the abrasion operation. Photographs shall be taken of the raised area prior to and after abrasion. The abraded area is then to be inspected to the dwg. requirements for ultrasonic and tap inspection. Report results to MRB.		

Gabriel M. Payne 8/17/93 CSD Design Engin'r
Mike Kufeld CSD QUALITY 8/17/93
USBI [signature] 8-18-93
DCMO CSD Cliff J. Hecht 8-18-93

684

D.R. # F 23
WITNESS COUPON
Attached with II

PAGE 2

NON-CONFORMANCE
REWORK/REPAIR PLANNING

Work Order Number:		Release No.:
5597-986-0005		MFGA96732
Part No.: B12003-09-01	NCR No.: D11927	Approvals: M.E. 9/13/93 Q.E. 9/13/93

Page 1 of 2

OPERATION	WORK CTR.	OPERATIONS INSTRUCTIONS		OPS	Q.C.	CUST.
			USBI			
			GOV'T 8-18-93	STP-DT	STP-DT	STP-DT

SCOPE
THIS PLANNING PROVIDES DETAILED INSTRUCTIONS TO REMOVE THE RIDGE ON THE BSM CLOSURE INSULATION. S/N W0442 NCR ITEM # 4.

CAUTION
DURING USE OF THE MOTO-TOOL TAKE CARE NOT TO MARK INSULATOR WITH MOTO-TOOL CHUCK,ANY MARKS MADE WITH CHUCK MAY BE CLEANED UP WITH 80 GRIT SAND PAPER.

0010

CAUTION
WORK SHALL BE PERFORMED IN A WELL LIT AREA.

P0020P04

685

REMOVE RIDGE FROM CLOSURE INSULATION SURFACE UNTIL IT IS FLUSH WITH SURROUNDING SURFACE USING MOTO-TOOL MODEL # YA 3950B WITH ALUMINUM OXIDE TIP P/N5000952, SET AT SPEED 5. DURING REMOVAL PROCESS NDT INSPECTOR SHALL INSPECT SURFACE PERIODICALLY TO ASSIST IN REMOVING THE MINIMAL AMOUNT OF MATERIAL SO NDT CAN BE PERFORMED. FINAL CLEAN UP OF AREA AND ANY MARKS MADE FROM THE CHUCK SHALL BE DONE WITH 80 GRIT SANDPAPER(P/N CSD 35030)AND A SANDING BLOCK.. USBI AND GOVT WITNESS.

8-18-93 RT VOID 8-18-93 SWH VOID

8-18-93 8-18-93 8-18-93 USBI

8-19-93 8-19-93 GOVT

GOVT VERIFY

QE 56 8/18/93 2301 CSD 8-18-93

WARNING

ISOPROPYL ALCOHOL IS FLAMMABLE. IT IS TOXIC BY INGESTION OR INHALATION. IT IS ALSO A SKIN AND EYE IRRITANT. ADEQUATE DILUTION VENTILATION IS REQUIRED. IN LIEU OF ADEQUATE VENTILATION, A RESPIRATOR WITH ORGANIC VAPOR FILTER CARTRIDGES IS REQUIRED. LATEX RUBBER, NEOPRENE, OR NITRILE GLOVES AND GOGGLES ARE ALSO REQUIRED.

0020 P0020P04

CLEAN SURFACE WITH A RYMPLE CLOTH DAMPENED WITH ISOPROPYL ALCOHOL. ALLOW TO AIR DRY 20 MINUTES MINIMUM.

OFFICIAL COPY

P 21 CVS

NON-CONFORMANCE
REWORK/REPAIR PLANNING

Work Order Number: 5597-986-0005		Release No.: MFGA96732	
Part No.: B12003-09-01	NCR No.: D11927		Page 2 of 2

OPERATION	WORK CTR.	OPERATIONS INSTRUCTIONS	OPS STP-DT	Q.C. STP-DT	CUST. STP-DT
0030	P0020P04	Q.C. VISUALLY INSPECT INSULATION REPAIR AREA. NO GOUGES OR DEPRESSIONS ALLOWED. USBI AND GOV'T INSPECT.			
0040	Q1319Q99	NDT PERFORM ULTRASONIC INSPECTION PER WORK INSTRUCTION 60.12.9-590 AND 60.12.9-553. MAP ON STANDARD (ORIGINAL) PLANNING DAR STEPS AND MAT OPERATIONS.			
0050	Q1319Q99	PERFORM UNBOND CALCULATION PER WORK INSTRUCTION 60.12.9-251 RECORD ON STANDARD (ORIGINAL) PLANNING DAR STEPS AND MAT OPERATIONS. USBI WITNESS.			
0060	QXXXXP99	Q.C. REVIEW NCR PLANNING POR COMPLETENESS. GOV'T REVIEW.			

258 CSD 8/19/93 USBI

GOV'T 8-19-93

41 CS 8-19-93

160 CSD 8-19-93 USBI 8/19

258 CSD 8/19/93 GOV'T 8-19-93

PG. 2 YMRC

Ultrasonic Report/ Calibration Sheet

Page 1 of 1

PART NAME: BSM NOZZLE ASSY	WORK ORDER NUMBER: 5597-986-0005
PART NUMBER: B12003-DS-01	PLANNING DOCUMENT INFO. Release No.: NCR 11927
Material: RUBBER	NCR No. (If applicable): NONE
Specification/technique: SE 1754 / 60/2.9553	Component Serial No.: WD442
	Project Name: BSM
	CALIBRATION CHECKS Initial: 1210 Time
	Intermediate: Time
	Final: 1225 Time

Quantity

Received	Inspected	Accepted	Rejected
1	1	1	Ø

Instrument/Serial Number: SONIC MK II	Calibration Date: 9-16-93
Transducer — Size/Frequency — Serial Number: .25/10. 922682	
Scanning Method: CONTACT	
Test Blocks/Standards: K 371	
COUPLANT: ULTRAGEL II	

INSTRUMENT SETTINGS

Sweep C. _____ F: _____

Delay C: 60 F: _____

dB 82 Reject On Off

Frequency: _____

EXAMINATION AREA	COMMENTS
100% of SANDED AREA	

Inspector: B. W Yeall Level: II Date: 8-19-93

C&D 2795 (92/03)

TAP TEST EXAMINATION DATA SHEET

IAW 22 0[illegible]
MRR 0051
P Hirschmann

PART NAME	PART NUMBER/DRAWING/REV	PLANNING DOCUMENT #
BSM NOZZLE ASSY	B12003-89-01	NCR 11927
WORK INSTRUCTION — TECH #	**ACCEPT/REJECT CRITERIA**	**HAMMER SIZE**
60.12.9 590-001	PER NCR	NONE
TYPE OF MATERIAL	**NCR #**	**PROJECT NO/WOR #**
RUBBER	NONE	5592-986-0005

ITEM S/N	IDENTIFICATION DESCRIPTION/REMARKS	ACC	RE
WO 442	NO REJ IND IN SANDED AREA	✱	✱

SKETCH

ACCEPTANCE DETERMINED BY CALCULATIONS AT DAR STEP 0024

INSPECTOR	LEVEL	DATE
G W Gill	II	8-19-93

CSD 3059 /92/08

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

NCR Disposition
Continuation Sheet

12 DISCREPANT ITEM NAME		13 DISCREPANT ITEM ID NO	28 ORIGINATOR	DATE	4 REF NCR NO	5 PAGE OF
BSM NOZZLE	DELTA QUALS	B12003-09-01	M. DELANEY	8-20-93	D11927	131

35 ITEM	36 QTY	37 REWORK CODE	38 ITEM DISPOSITION	39 OPERATIONS	40 QUALITY
			INTERIM DISPOSITION #5		
			CONTINUE PROCESSING THROUGH FINAL ASSY OF MOTOR ALD UP TO BUT NOT INCLUDING ENVIRONMENTAL TESTING. STOP AT OPERATION 0010, STEP 160 OF P.I. 07.2.046.		
			DESIGN ENG. Isabelle M. Payne 8/20/93		
			QUALITY ENG. Myron E. Farris 8/20/93		
			USBI [illegible] 8-20-93		
			GOV'T [illegible] 8/21/93		

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Pg 131 of 206 pages in NCR D11927 Chrono

DISC P/N: B12003-09-01
DISC P/NAME: BSM NOZZLE,QUAL 2
MFG PART NO: N/A
MFG PART NM: N/A
MFG SER NO: N/A
PLAN REL: MFGA96732 UOM: EA
PROJECT NO: 5597 LOT SIZE: 1
BUILDING: 0020 REJECT NO: 1
WORK AREA: P8S CAR/FRR:

NCR DATE: 08/02/93
DISPOSITION DATE: 08/19/93
CLOSE DATE: 08/27/93
DPRO COMMENTS: NO

PO:
VENDOR NO: 000000
VEND NAME:
VEND DOC NO: N/A

INSPECTOR	ADRIAN RANDLES	08/06/93
VALIDATION	MIKE KISKILA	08/16/93
DISPOSITION	LARRY MURPHY	08/19/93
CAUSE/CA (UTC)	MARY DELANEY	08/20/93
CAUSE/CA (VEN)	N/A	
QUAL DES ENGR	MYRNA GARCIA	08/20/93
CUSTOMER	PAUL LUNDY	08/27/93
CUSTOMER		
GOVT REP	-N/A-	08/27/93
MFG ENG REWORK	CHET SKROCKI	08/27/93
INSP ACCEPT	MARK RADOVIC	08/27/93

NCR NARRATIVE

SEE VMRR 006186 FOR DISPOSITION AUTHORITY. MK 8/20/93
SEE ATTACHED INTERIM DISPOSITION # 1 TO CONTINUE PROCESSING.MGG 8/23/93
INTERIM DISPOSITION # 2 TO CONTINUE PROCESSSING. CD 8/23/93
VMRR APPROVED. CD 8/27/93

ITEM INFORMATION

ITEM:	OPER NO:	AFF QTY:	SERIAL NO:	DWG SPEC:	DEFECT CODE:	RESP ORGN:	OCC/REC:	DISP CODE:	DISP QTY
01	D020	1	W0442	8/D	215 58	21100	001	RP	1
02	D021	1	W0442	8/D	215 58	21100	001	A	1

DISCREPANCY & DISPOSITION

ITEM: DISCREPANCY DESCRIPTION:

01 S/B:1.998 TO 2.098
IS:1.978 APPROX 210DEG A 1.0" LENGTH

02 S/B:2.078"TO 2.178"
IS:2.073" APPROX 210DEG,/ 1.0" LENGTH

DISPOSITION DESCRIPTION:

REPAIR. RISPW UNAFFECTED. REPAIR BY THE FOLLOWING PROCEDURE:

1. USING A SHARP CUTTING TOOL,REMOVE THE INSULATOR BACK TO THE INSIDE EDGE OF THE LIP (0.15 INCHES MAX.) FOR A CIRCUMFERENTIAL LENGTH OF APPROX. 1.4 INCHES CENTERED ON THE DISCREPANT AREA. ROUND THE INSIDE CUT CORNERS.
2. ABRADE THE RUBBER AND ALUMINUM EXPOSED SURFACES WITH 180 TO 400 GRIT ALUMINUM OXIDE PAPER TO REMOVE RUBBER AND ADHESIVE FROM ALUMINUM SURFACE AND ROUGHEN RUBBER SURFACE. CLEAN AREA WITH REVEILLE CLEANER, WIPE DRY WITH CLEAN RYMPLE CLOTH AND ALLOW TO DRY FOR 20 MINUTES MIN.
3. APPLY RTV 102 TO CUTOUT AREA AND BUILD UP FLUSH WITH ADJACENT LIP SURFACES AND OUTER DIAMETER TO FLUSH OR WITHIN 0.016 INCHES PER DWG REQUIREMENTS. CURE PER MFG. INSTRUCTIONS. TRIM AS REQUIRED TO ACHIEVE THESE REQMTS.

RATIONALE:
THERE IS A STANDARD REPAIR ALLOWED BY THE DRAWING FOR CONDIT IONS WHERE THE INSULATOR DOES NOT EXTEND RADIALLY OUTBOARD TO THE O.D. OF THE NOZZLE CLOSURE. RTV 102 IS USED IN THIS STANDARD REPAIR DUE TO ITS ADHESIVE QUALITIES AND HIGH TEMPERATURE CAPABILITIES. BUILDUP OF THIS AREA OF THIS INSULATOR USING RTV 102 IS THEREFORE A FLIGHT QUALIFIED REPAIR.
USE-AS-IS. RISPW UNAFFECTED. THE INSULATOR HEIGHT OF .005 INCHES BELOW THE MINIMUM REQUIREMENT WILL NOT AFFECT THE INSULATION AND ABLATION PROTECTION REQUIRED FOR THE INSULA-

TOR. THE INSULATOR IN THIS AREA IS APPROXIMATELY 0.190 INCH THICK. FROM FIRED GROUND AND FLIGHT HARDWARE MEASUREMENTS, ONLY 0.040 TO 0.050 INCHES OF RUBBER IS REMOVED DURING THE MOTOR ACTION TIME. THIS EROSION/ABLATION LEAVES APPROXIMATELY 0.140 INCHES OF INSULATING MATERIAL WHICH IS OVER 0.040 INCHES GREATER THAN THE ORIGINAL THICKNESS OF ADJ. INSULATOR LIP (0.10). ONE-HALF OF THE LIP THICKNESS REMAINS AFTER THE MOTOR OPERATION. THEREFORE, THE LOWER THICKNESS OF THE INSULATOR IN THIS AREA WILL NOT AFFECT THE PERFORMANCE OF THE NOZZLE CLOSURE.

CAUSE & CORRECTIVE ACTION

ITEM:	CAUSE CODE:	CAUSE NARRATIVE:	CA CODE:	CORRECTIVE ACTION NARRATIVE:
01	11	THE DEPRESSION IN THE AFT CLOSURE INSULATION OF THE DELTA QUALIFICATION NOZZLE ASSEMBLY WAS CAUSED BY AN EXCESSIVE AMOUNT OF BLEEDER CLOTH WHICH WAS PLACED IN THE VACUUM BAG OVER THE INSULATOR FORMING DONUT.	11	THE CORRECTIVE ACTION WILL BE TO CONTROL THE AMOUNT OF BLEEDER CLOTH INSTALLED IN THE VACUUM BAG. ONLY TWO LAYERS OF NYLON RELEASE CLOTH WILL BE USED OVER THE FORMING DONUT. THIS METHOD OF BAGGING IS SIMILAR TO THAT USED ON THE DEMONSTRATION UNITS. THIS CORRECTIVE WILL BE CONFIRMED BY THE FABRICATION OF ONE ADDITIONAL DEMONSTRATION UNIT. THE NOZZLE ASSEMBLY PRODUCTION PLANNING FOR LOT ABA WILL THEN BE REVISED TO CONTROL THE AMOUNT OF BLEEDER CLOTH INSTALLED AND A PICTORIAL DEPICTION OF THE PROPER BAGGING TECHNIQUE WILL BE ADDED TRAINING SESSIONS WILL BE CONDUCTED AND DOCUMENTED TO INSURE OPERATORS WHO PERFORM INSULATION VULCANIZATION PROCESSES ARE KNOWLEDGEABLE REGARDING PLANNING AND PROCESS REQUIREMENTS. THE NOZZLE ASSEMBLY DRAWINGS WILL BE REVISED TO SPECIFY THE ALLOWED POST-VULCANIZATION CONTOUR OF THE INSULATOR.
02	11	SEE ITEM 1.	11	SEE ITEM 1.

UNITED TECHNOLOGIES USBI

PAGE 1 OF 29

VMRR NO. 006186

VENDOR MATERIAL REVIEW REPORT

1 NAME	2 PART/SPEC NO	3 DASH NO	4 REV	5 ECO NO	6 USBI SERIAL/LOT NO	7 LOT SIZE	8 QTY ACC	9 QTY REJ	10 U/M
NOZZLE ASSEMBLY NO. QUAD 2	B12003-09	01	#1	5396-00222	W0442	1	0	1	EA

11 PO NO	12 ITEM	13 WOR NO	14 VENDOR NAME AND ADDRESS	15 VENDOR ID NO	16 DATE
018333	N/S	4052-501-0009	UTC/CSD P.O. BOX 49028 SAN JOSE CA 95161-9028	30120	8/19/93

17 ITEM NO	18 QTY	19 DWG ZONE SPEC PAR	20 DWG/SPEC REQ (INCLUDE TOLERANCE)	21 NONCONFORMANCE/DESCRIPTION OF TROUBLE (ACTUAL READING OR CONDITION)
1	1	E-7	B12003-XX-XX	S/B: 1.998" TO 2.098"
				I/S: 1.978 APPROXIMATELY AT 210° AND IS 1.0" LONG AREA
2	1	E-7	B12003-XX-XX	S/B: 2.078" TO 2.178"
				I/S: 2.073" APPROXIMATELY AT 210° AND IS 1.0" LONG AREA
				REF: CSD NCR D11959

22 REPETITIVE NONCONFORMANCE — X NO — YES _____ TIMES IN _____ MONTH VMRR NO

USE OF NONCONFORMANCE AND CORRECTIVE ACTION TAKEN TO PREVENT RECURRENCE

SEE ATTACHMENT I FOR CAUSE AND CORRECTIVE ACTION AS SATISFIED ON NCR D11959

24 FAILURE REPORT	25 EFFECTIVITY OF CORRECTIVE ACTION SN OR DATE	26 CONFIRMING TWX
X NO YES REPORT NO _____	LOT ABA	X NO YES TWX NO _____

27 QUALITY CONT. INSPECTOR	DATE	28 QUALITY CONTROL SUPERVISION	DATE	29 USBI REPRESENTATIVE	DATE
Dickie Clay DCMC	8/20/93	M. Kuhl	8/20/93		8-20-93

SPACE BELOW RESERVED FOR USBI

PRELIMINARY REVIEW X MATERIAL REVIEW BOARD

30 ITEM NO	31 QTY	32 ORGN RESP	33 DISP CODE	34 DISPOSITION INSTRUCTIONS	35 QC ACCEPT
1	1	V	B	REPAIR PER INSTRUCTIONS OF PG. 2.	USBI 93 SOURCE INSP 9-3-93
2	1	V	A	USE AS IS. SEE PAGE 2 FOR RATIONALE.	USBI 93 SOURCE INSP 9-3-93

ATIONAL CORRECTIVE ACTION REQUIREMENTS IF ANY

37 QUALITY ENGINEER	DATE	38 ENGINEERING REPRESENTATIVE	DATE	39 CUSTOMER APPROVAL	DATE
Edward L. Buckley	8-26-93	Vernon K. Burke	8/25/93	John M. Rojas DCMC	27 AUG 93

USB 1453 (88/01)

Item: 1, Qty: 1

Repair for use in qualification testing. Use the procedure described in item 1 of NCR D11959 to cut out discrepant area and replace with RTV 102. Repair of radial offsets of the insulator relative to the closure outer diameter using the RTV 102 is a qualified procedure which is allowed by the nozzle assembly drawing. Cutting out the discrepant area is necessary to maximize the adhesive bond of the RTV 102 material to the insulator and closure materials.

Item: 2, Qty: 1

Use-as-is for qualification testing. The .005 inch thinner section of insulator exists for only one inch of the circumference of the closure (approx. 36 inches) and is insignificant compared to the remaining thickness of the insulator (approximately .190 inches). Only 0.040 to 0.050 inches of insulator is removed during the BSM function due to erosion/ablation leaving approximately 0.140 inches of insulator. The remaining thickness of insulator at the discrepant area will be sufficient to protect the closure and insure that motor performance is not affected.

Terence L. Burke 8/25/93
USBI Engineering

Edward J. Buckley 8-26-93
USBI Quality

John M Reese
DCMC Q.E. 27 Aug 93

USBI 93 SOURCE INSP.
9-3-93

NCR: D11959 PLANT: COY DISC CAT: NT REF NO: N/A PR/MRB: MRB MC/OB: REPORT DATE: 08/26/93 PAGE: 1

DISC P/N: B12003-09-01
DISC P/NAME: BSM NOZZLE,QUAL 2
MFG PART NO: N/A
MFG PART NM: N/A
MFG SER NO: N/A
PLAN REL: MF6A96732
PROJECT NO: 5597
BUILDING: 0020
WORK AREA: PBS

UOM: EA
LOT SIZE: 1
REJECT NO: 1
CAR/FRR:

NCR DATE: 08/02/93
DISPOSITION DATE: 08/19/93
CLOSE DATE:
DPRO COMMENTS: NO

PO:
VENDOR NO: 000000
VEND NAME:
VEND DOC NO: N/A

INSPECTOR	ADRIAN RANDLES	08/06/93
VALIDATION	MIKE KISKILA	08/16/93
DISPOSITION	LARRY MURPHY	08/19/93
CAUSE/CA (DTC)	MARY DELANEY	08/20/93
CAUSE/CA (VFN)	N/A	
QUAL DES ENGR	MYRNA GARCIA	08/20/93
CUSTOMER		
CUSTOMER		
GOVT REP		

NCR NARRATIVE

SEE VMRR 006186 FOR DISPOSITION AUTHORITY. MK 8/20/93
SEE ATTACHED INTERIM DISPOSITION # 1 TO CONTINUE PROCESSING.MGG 8/23/93
INTERIM DISPOSITION # 2 TO CONTINUE PROCESSSING. CD 8/23/93

ITEM INFORMATION

ITEM:	OPER NO:	AFF QTY:	SERIAL NO:	DWG SPEC:	DEFECT CODE:	RESP ORGN:	OCC/REC:	DISP CODE:	DISP QTY
01	0020	1	M0442	8/D	215 58	21100	001	RP	1
02	0021	1	M0442	8/D	215 58	21100	001	A	1

DISCREPANCY & DISPOSITION

ITEM: DISCREPANCY DESCRIPTION:

01 S/B:1.998 TO 2.098
IS:1.978 APPROX 210DEG A 1.0" LENGTH

DISPOSITION DESCRIPTION:
REPAIR. RISPN UNAFFECTED. REPAIR BY THE FOLLOWING PROCEDURE:

1. USING A SHARP CUTTING TOOL,REMOVE THE INSULATOR BACK TO THE INSIDE EDGE OF THE LIP (0.15 INCHES MAX.) FOR A CIRCUMFERENTIAL LENGTH OF APPRDX. 1.4 INCHES CENTERED ON THE DISCREPANT AREA. ROUND THE INSIDE CUT CORNERS.
2. ABRADE THE RUBBER AND ALUMINUM EXPOSED SURFACES WITH 180 TO 600 GRIT ALUMINUM OXIDE PAPER TO REMOVE RUBBER AND ADHESIVE FROM ALUMINUM SURFACE AND ROUGHEN RUBBER SURFACE. CLEAN AREA WITH REVEILLE CLEANER, WIPE DRY WITH CLEAN RYMPLE CLOTH AND ALLOW TO DRY FOR 20 MINUTES MIN.
3. APPLY RTV 102 TO CUTOUT AREA AND BUILD UP FLUSH WITH ADJACENT LIP SURFACES AND OUTER DIAMETER TO FLUSH OR WITHIN 0.016 INCHES PER DWG REQUIREMENTS. CURE PER MFG. INSTRUCTIONS. TRIM AS REQUIRED TO ACHIEVE THESE REQMTS.

RATIONALE:
THERE IS A STANDARD REPAIR ALLOWED BY THE DRAWING FOR CONDITIONS WHERE THE INSULATOR DOES NOT EXTEND RADIALLY OUTBOARD TO THE O.D. OF THE NOZZLE CLOSURE. RTV 102 IS USED IN THIS STANDARD REPAIR DUE TO ITS ADHESIVE QUALITIES AND HIGH TEMPERATURE CAPABILITIES. BUILDUP OF THIS AREA OF THIS INSULATOR USING RTV 102 IS THEREFORE A FLIGHT QUALIFIED REPAIR. USE-AS-IS. RISPN UNAFFECTED. THE INSULATOR HEIGHT OF .005 INCHES BELOW THE MINIMUM REQUIREMENT WILL NOT AFFECT THE INSULATION AND ABLATION PROTECTION REQUIRED FOR THE INSULATOR. THE INSULATOR IN THIS AREA IS APPROXIMATELY 0.190 INCH THICK. FROM FIRED GROUND AND FLIGHT HARDWARE MEASUREMENTS,

02 S/B:2.078"TO 2.178"
IS:2.073" APPROX 210DEG./ 1.0" LENGTH

694

ONLY 0.040 TO 0.050 INCHES OF RUBBER IS REMOVED DURING THE MOTOR ACTION TIME. THIS EROSION/ABLATION LEAVES APPROXIMATE LY 0.140 INCHES OF INSULATING MATERIAL WHICH IS OVER 0.040 INCHES GREATER THAN THE ORIGINAL THICKNESS OF ADJ. INSULATOR LIP (0.10). ONE-HALF OF THE LIP THICKNESS REMAINS AFTER THE MOTOR OPERATION. THEREFORE, THE LOWER THICKNESS OF THE INSU LATOR IN THIS AREA WILL NOT AFFECT THE PERFORMANCE OF THE NOZZLE CLOSURE.

CAUSE & CORRECTIVE ACTION

ITEM:	CAUSE CODE:	CAUSE NARRATIVE:	CA CODE:	CORRECTIVE ACTION NARRATIVE:
01	11	THE DEPRESSION IN THE AFT CLOSURE INSULATION OF THE DELTA QUALIFICATION NOZZLE ASSEMBLY WAS CAUSED BY AN EXCESSIVE AMOUNT OF BLEEDER CLOTH WHICH WAS PLACED IN THE VACUUM BAG OVER THE INSULATOR FORMING DONUT.	11	THE CORRECTIVE ACTION WILL BE TO CONTROL THE AMOUNT OF BLEEDER CLOTH INSTALLED IN THE VACUUM BAG. ONLY TWO LAYERS OF NYLON RELEASE CLOTH WILL BE USED OVER THE FORMING DONUT. THIS METHOD OF BAGGING IS SIMILAR TO THAT USED ON THE DEMONSTRATION UNITS. THIS CORRECTIVE WILL BE CONFIRMED BY THE FABRICATION OF ONE ADDITIONAL DEMONSTRATION UNIT. THE NOZZLE ASSEMBLY PRODUCTION PLANNING FOR LOT ABA WILL THEN BE REVISED TO CONTROL THE AMOUNT OF BLEEDER CLOTH INSTALLED AND A PICTORIAL DEPICTION OF THE PROPER BAGGING TECHNIQUE WILL BE ADDED TRAINING SESSIONS WILL BE CONDUCTED AND DOCUMENTED TO INSURE OPERATORS WHO PERFORM INSULATION VULCANIZATION PROCESSES ARE KNOWLEDGEABLE REGARDING PLANNING AND PROCESS REQUIREMENTS. THE NOZZLE ASSEMBLY DRAWINGS WILL BE REVISED TO SPECIFY THE ALLOWED POST-VULCANIZATION CONTOUR OF THE INSULATOR.
02	11	SEE ITEM 1.	11	SEE ITEM 1.

Exhibit 4 of 9
VMR 0061
Attachment
#1 Attachment

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

NCR Disposition
Continuation Sheet

QE 88 3 9/22/93

12 DISCREPANT ITEM NAME	13 DISCREPANT ITEM DWG	28 INITIATOR	DATE	4 NCR NO	5 PAGE OF
BSM Nozzle Quill	BLOO3-09-01	Mary DeLaney	8/19/93	DU959	2 1

35 ITEM	36 QTY	37 DISP CODE	38 ITEM DISPOSITION	39 INITIALS	40 DATE OF
4			INTERIM DISPOSITION #1 PERFORM REPAIR AS DISPOSITIONED ON ITEM #1 (SEE ATTACHED) USING NCR REPAIR PLANNING REPORT COMPLETION OF REPAIR TO MRB DESIGN ENG. Judith M. Payne 8/20/93 QUALITY ENG. Myron J. Jones 8/20/93 USBI [illegible] 8-20-93 GOVT Nadine Ashley 8/20/93		

Pg 5 of 5 pgs
Attachment
ATTACHED

969

UNITED TECHNOLOGIES CHEMICAL SYSTEMS

NCR Disposition
Continuation Sheet

12 DISCREPANT ITEM NAME	13 DISCREPANT ITEM P/N	28 ORIGINATOR	DATE	4 REF NCR NO	5 PAGE
BSM NOZZLE, QUAD 2	B12003-09-01	MARY DELANEY	8-20-93	D11959	4

35 ITEM	36 QTY	37 DISP CODE	38 ITEM DISPOSITION	39	40

INTERIM DISPOSITION #2

CONTINUE PROCESSING THROUGH FINAL ASSY OF MOTOR AND UP TO BUT NOT INCLUDING ENVIRONMENTAL TESTING. STOP AT OPERATION 0010, STEP 160 OF P.I. 07.2.046.

DESIGN ENG Stephen M. Payne 8/23/93
QUALITY ENG [signature] 8/23/93
USBI [signature] 8/23/93
GOVT [signature] 8/24/93

pg. 6 of P
VMRR 006180
4 pages

697

NON-CONFORMANCE
REWORK/REPAIR PLANNING

Work Order Number:		Release No.:	
5597-986-0005		MFGA96732	
Part No.: B12003-09-01	NCR No.: D11959	Approvals: M.E. 8/20/93 Q.E. 8/20/93 USBI. 8-20-93 PSE: 8/20/93 Bl. Mgt 8/20/93 NO SAFETY	Page 1 of 2

OPERATION	WORK CTR.	OPERATIONS INSTRUCTIONS	OPS	Q.C.	CUS
			STP-DT	STP-DT	STP-I

SCOPE

This NCR planning is to be used to repair the Delta Qual nozzle assembly S/N WO442, DISCREPANCY ITEM #1..

For applicable warnings see P.I. 07.2.048

0010-00-0	P0020P04	USING A SHARP CUTTING TOOL REMOVE THE INSULATOR BACK TO THE INSIDE LIP EDGE (0.15" MAX) FOR A CIRCUMFERENTIAL LENGTH OF APPROXIMATELY 1.4" CENTERED ON THE DISCREPANT AREA. ROUND THE INSIDE CUT CORNERS. D48 CSD 8-21-93 8-21-93
0020-00-0	P0020P04	ABRADE THE RUBBER AND ALUMINUM EXPOSED SURFACES WITH 180 TO 400 GRIT ALUMINUM OXIDE PAPER TO REMOVE RUBBER AND THE SURFACE FROM ALUMINUM SURFACE AND ROUGHEN RUBBER SURFACE. CLEAN AREA WITH REVEILLE CLEANER, WIPE DRY WITH CLEAN RYSPER AND ALLOW TO DRY FOR 20 MINUTES MINIMUM. 8-21-93
0030-00-0	P0020P04	**WARNING** APPLY RTV 102 TO CUTOUT AREA AND BUILD UP FLUSH WITH ADJACENT LIP SURFACES AND OUTER DIAMETER TO FLUSH OR WITHIN 0.016" PER DRAWING REQUIREMENTS. ~~FILL BOTH DISCREPANT AREAS ON INSULATOR WITH RTV-102. SMOOTH REPAIRED AREA AS~~ SMOOTH REPAIRED AREA AS REQUIRED. D48 CSD 8-21-93 8-23-93
0040-00-0	P0020P04	CURE RTV-102 AT AMBIENT TEMPERATURE FOR ONE (1) HOUR MINIMUM OR UNTIL FIRM. 8-23-93

OFFICIAL COPY

FE 60

NON-CONFORMANCE
REWORK/REPAIR PLANNING

Work Order Number: 5597-986-0005		Release No.: MFGA96732	
Part No.: B12003-09-01	NCR No.: D11959		Page 2 of 2

OPERATION	WORK CTR.	OPERATIONS INSTRUCTIONS	OPS STP-DT	Q.C STP-DT	CUST. STP-DT
0050-00-0	P0020P04	TRIM RTV-102 AS REQUIRED, TO ACHIEVE DIMENSIONAL REQUIREMENTS IN STEP 030..			
0060-00-0	QXXXXQ99	Q.C. VERIFY THAT REPAIR IS COMPLETE.			

8-23-93

8/23/93

USBI 8/23/9

699

PLANT CODE	CSMS CONTRACT NUMBER	DATE	TIME	PAGE	ORDER NUMBER

ORDER QUANTITY	UOM	PICKLIST NUMBER	ASSEMBLY PART NUMBER	PICKLIST STATUS
1	EA			

DESCRIPTION

PLANNER

ITEM	PART NUMBER	UOM

DESCRIPTION

BIN LOCATION	SERIAL/LOT

SHELF EXP DATE	LINE	CSMS C/N	ORDER NO

REQUIRED QUANTITY	QUANTITY ISSUED	ISSUED BY

NOT USED

ITEM	PART NUMBER	UOM

DESCRIPTION

BIN LOCATION	SERIAL/LOT

SHELF EXP DATE	LINE	CSMS C/N	ORDER NO.

REQUIRED QUANTITY	QUANTITY ISSUED	ISSU

NOT USED

ITEM	PART NUMBER	UOM

DESCRIPTION

BIN LOCATION	SERIAL/LOT

SHELF EXP DATE	LINE	CSMS C/N	ORDER NO

REQUIRED QUANTITY	QUANTITY ISSUED	ISSUED BY

NOT USED

ITEM	PART NUMBER	U

DESCRIPTION

BIN LOCATION	SERIAL/LOT

SHELF EXP DATE	LINE	CSMS C/N	ORDER NO.

REQUIRED QUANTITY	QUANTITY ISSUED	ISSU

NOT USED

ITEM	PART NUMBER	UOM

DESCRIPTION

BIN LOCATION	SERIAL/LOT

SHELF EXP DATE	LINE	CSMS C/N	ORDER NO

REQUIRED QUANTITY	QUANTITY ISSUED	ISSUED BY

NOT USED

ITEM	PART NUMBER	U

DESCRIPTION

BIN LOCATION	SERIAL/LOT

SHELF EXP DATE	LINE	CSMS C/N	ORDER NO.

REQUIRED QUANTITY	QUANTITY ISSUED	ISSU

NOT USED

ITEM	PART NUMBER	UOM

DESCRIPTION

BIN LOCATION	SERIAL (LOT)
FS0020	LTN082367

SHELF EXP DATE	LINE	CSMS C/N	ORDER NO
10-27-93	01		

REQUIRED QUANTITY	QUANTITY ISSUED	ISSUED BY
		B 303

ITEM	PART NUMBER	U

DESCRIPTION

BIN LOCATION	SERIAL/LOT

SHELF EXP DATE	LINE	CSMS C/N	ORDER NO.

REQUIRED QUANTITY	QUANTITY ISSUED	ISSU

NCR: D08262 PLANT: COY DISC CAT: RI REF NO: N/A PR/MRB: MRB WC/OB: REPORT DATE: 07/26/93 PAGE: 1

DISC P/N: SE0754
DISC P/NAME: HX-752
MFG PART NO: N/A
MFG PART NM: N/A
MFG SER NO: LOT 50
PLAN REL: QC0007965
PROJECT NO: 5592
BUILDING: 1210
WORK AREA: QLR

UOM: LB
LOT SIZE: 72
REJECT NO: 72
CAR/FRR:

NCR DATE: 04/02/92
DISPOSITION DATE: 04/07/92
CLOSE DATE: 04/23/92
DPRO COMMENTS: NO

PO: PZ0407347
VENDOR NO: 013362
VEND NAME: THREE M CO./IND. CH
VEND DOC NO: N/A

INSPECTOR	N/A	
VALIDATION	AMANDA RAMIREZ	04/02/92
DISPOSITION	JOSEPH HENRY	04/02/92
CAUSE/CA (UTC)	N/A	04/07/92
CAUSE/CA (VEN)	CAROL DANIELS	
QUAL DES ENGR	CAROL DANIELS	04/09/92
CUSTOMER	DWAYNE W. WILSON	04/09/92
CUSTOMER		04/11/92
GOVT REP	CLIFF SHERLOCK	
MFG ENG REWORK	N/A	04/16/92
PURCH BUYER	N/A	04/16/92
INSP ACCEPT	MYRNA LEFTWICH	04/16/92
		04/23/92

NCR NARRATIVE

TWO COMPOSITE SAMPLES WERE TESTED FOR LOT ACCEPTANCE. THE INFRARED SCAN DOES MATCH THE QC LAB'S INTERNAL REFERENCE. SEE NCRS D07544, D07057 AND CAR D07057. CD 4/9/92

ITEM INFORMATION

ITEM:	OPER NO:	AFF QTY:	SERIAL NO:	DWG SPEC:	DEFECT CODE:	RESP ORGN:	OCC/REC:	DISP CODE:	DISP QTY
01	N/A	72	LOT 50	SE0754D 3.3	695 58	QACA	R	A	72

DISCREPANCY & DISPOSITION

ITEM: 01

DISCREPANCY DESCRIPTION:
THE PEAKS ON THE INFRARED SPECTRUM SHALL BE WITHIN (+/-) 5 MICRONS OF THE CORRESPONDING PEAKS OF THE REFERENCE SPECTRUM -THERE ARE PEAKS (@8&13.5 MICRONS) ON THE SAMPLES SPECTRUM OF WHICH THERE ARE NO CORRESPONDING PEAKS ON THE SPECIFICATION'S REFERENCE SPECTRUM.

DISPOSITION DESCRIPTION:
USE AS IS. RISPW UNAFFECTED. IR SCAN MATCHES QC LAB REFERENCE SCAN WHICH WAS GENERATED WITH MORE MODERN EQUIPMENT THAN THE SPECIFICATION SCAN. THE LOT 50 AND QC LAB SCANS SHOW BANDS IN THE REGION OF 1250 TO 1190 1/CM (8-8.4 MICRONS) AND 800 - 667 1/CM (12.9 - 15 MICRONS) WHICH DO NOT -CONT. APPEAR IN THE SPECIFICATION SCAN. THESE REGIONS CORRESPOND TO THE ABSORPTION BANDS OF CHLOROFORM, THE IR CARRIER SOLVENT. THUS LOT 50 IR SCAN DOES NOT REVEAL ANY CONTAMINATION. A CHANGE REQUEST IS BEING PREPARED TO UPDATE THE SPECIFICATION REFERENCE SCAN.

CAUSE & CORRECTIVE ACTION

ITEM:	CAUSE CODE:	CAUSE NARRATIVE:	CA CODE:	CORRECTIVE ACTION NARRATIVE:
01	40	SEE CAR D07057	40	SEE CAR D07057

NCR: D08388 PLANT: VEN DISC CAT: RT REF NO: N/A PR/MRB: MRB WC/OB: REPORT DATE: 07/26/93 PAGE: 1

DISC P/N: SE0724
DISC P/NAME: ANTIOXIDANT 2246 (A02246)
MFG PART NO: N/A
MFG PART NM: N/A
MFG SER NO: LOT 20
PLAN REL: 0007989
PROJECT NO: 5594
BUILDING: 1210
WORK AREA: QLR

UOM: LB
LOT SIZE: 50
REJECT NO: 50
CAR/FRR:

NCR DATE: 04/14/92
DISPOSITION DATE: 04/21/92
CLOSE DATE: 06/01/92
DPRO COMMENTS: YES

PO: PZ0407343
VENDOR NO: 001981
VEND NAME: AMERICAN CYANAMID
VEND DOC NO: N/A

INSPECTOR	N/A	04/14/92
VALIDATION	RUSSELL GIBSON	04/14/92
DISPOSITION	RAYMA RODRIGUEZ	04/21/92
CAUSE/CA (UTC)	N/A	
CAUSE/CA (VEN)	CAROL DANIELS	05/12/92
QUAL DES ENGR	CAROL DANIELS	05/12/92
CUSTOMER	DWAYNE W. WILSON	05/22/92
CUSTOMER		
GOVT REP	RAYMOND CORREA	05/27/92
MFG ENG REWORK	N/A	05/27/92
PURCH BUYER	N/A	05/27/92
INSP ACCEPT	MYRNA LEFTWICH	06/01/92

NCR NARRATIVE

MATERIAL PURCHASED THROUGH DISTRIBUTOR WILLIAM F. MCDONALD VENDOR NO. 17214
NOTE: INFRARED SPECTRUM DOES MATCH Q.C. LAB'S INTERNAL REFERENCE.

ITEM INFORMATION

ITEM	OPER NO	AFF QTY	SERIAL NO	DWG SPEC	DEFECT CODE	RESP ORGN	OCC/REC	DISP CODE	DISP QTY
01	N/A	50	LOT 20	SE0724 3.3	695 58	QACA	0	A	50

DISCREPANCY & DISPOSITION

ITEM 01

DISCREPANCY DESCRIPTION:
THE PEAKS ON THE INFRARED SPECTRUM SHALL BE WITHIN +/- 5 MICRONS OF THE CORRESPONDING PEAKS OF THE REFERENCE SPECTRUM. THERE ARE PEAKS (@ 8 & 13.5 MICRONS) ON THE SAMPLES SPECTRUM OF WHICH THERE ARE NO CORRESPONDING PEAKS ON THE REFERENCE SPECTRUM.

DISPOSITION DESCRIPTION:
USE AS IS. RISPW UNAFFECTED. IR SCAN MATCHES THE QC LAB REFERENCE SCAN WHICH WAS GENERATED WITH MORE MODERN EQUIPMENT THAN THE SPECIFICATION SCAN. THE 8 AND 13.5 MICRON CORRESPOUND TO THE ABSORPTION PEAKS OF THE CHLOROFORM CARRIER. A CHANGE REQUEST IS BEING PREPARED TO UPDATE (CONT'ED) THE SPECIFICATION IR REFERENCE SCAN.

CAUSE & CORRECTIVE ACTION

ITEM	CAUSE CODE	CAUSE NARRATIVE	CA CODE	CORRECTIVE ACTION NARRATIVE
01	40	SEE CAR D8388.	40	SEE CAR D8388.

THE SHUTTLE FAILURE. ORIGINAL PACKAGING WAS INADEQUATE FOR THAT LENGTH OF STORAGE TIME.

02 13 CLOSURES WERE MADE BY AN OUTSIDE SOURCE AND THEIR METHODS AND PROCEDURES WERE NOT ADEQUATE FOR MEETING DWG REQUIREMENTS/TOLERANCES. THIS IS THE SAME PROBLEM AS ON NCR D8012.

03 13 SEE ITEM 2.

PARTS IN THE FUTURE. IN-PROCESS PARTS ARE ALODINED TO PREVENT CORROSION AND AFTER ASSEMBLY THE HARDWARE IS STORED IN A CONTROLLED ENVIRONMENT. CURRENT PARTS IN INVENTORY ARE BEING CHECKED FOR CORROSION PRIOR TO USE.

13 CURRENT PRODUCTION ORDER HAS BEEN FILLED. SJO (CSD) PLANNING WILL BE REVIEWED AND APPROVED BY CSD AND USBI PRIOR TO START OF ANY NEW PRODUCTION. THE REMAINING CLOSURES IN STOCK ARE BEING DIMENSIONALLY CHECKED PRIOR TO USE.

13 SEE ITEM 2.

NCR: D10275 PLANT: COY DISC CAT: MT REF NO: N/A PR/MRB: MRB WC/OB: REPORT DATE: 08/04/93 PA 1

DISC P/N: 812018-14-01
DISC P/NAME: CORROSION INSP.CLOSURES
MFG PART NO: N/A
MFG PART NM: N/A
MFG SER NO: N/A
PLAN REL: MULTIPLE
PROJECT NO: 5592
BUILDING: 0020
WORK AREA: PBS

UOM: EA
LOT SIZE: 14
REJECT NO: 12
CAR/FRR:

NCR DATE: 11/23/92
DISPOSITION DATE: 01/25/93
CLOSE DATE: 02/16/93
DPRO COMMENTS: NO

PO: N/A
VENDOR NO: 000000
VEND NAME:
VEND DOC NO: N/A

INSPECTOR	MARK RADOVIC	
VALIDATION	CAROL DANIELS	01/26/93
DISPOSITION	LARRY MURPHY	01/22/93
CAUSE/CA (UTC)	N/A	01/25/93
CAUSE/CA (VEN)	CAROL DANIELS	
QUAL DES ENGR	CAROL DANIELS	01/26/93
CUSTOMER	DWAYNE W. WILSON	01/26/93
CUSTOMER		01/26/93
GOVT REP		
MFG ENG REWORK	RAYMOND CORREA	01/27/93
INSP ACCEPT	CHET SKROCKI	01/29/93
	MARK RADOVIC	02/16/93

NCR NARRATIVE

MFGA 14004 S/N 10696,W0442,10633,10620,10706,& 10676;MFGA 14005 S/N 10713, 10627,10687,10730,10655,10663,10658,& 10668.MKR 11/23/92.

ITEM INFORMATION

ITEM:	OPER NO:	AFF QTY:	SERIAL NO:	DWG SPEC:	DEFECT CODE:	RESP ORGN:	OCC/REC:	DISP CODE:	DISP QTY
01	MAT 0030	1	W0442	B12006-02-01 D/N 3	250 22	QACA	0	SRP	1
02	MAT 0040	12	MULTIPLE	B12006-02-01 5/F	245 58	QACA	0	A	12
03	MAT 0040	4	MULTIPLE	B12006-02-01 5/F	245 58	QACA	0	A	4

DISCREPANCY & DISPOSITION

ITEM: DISCREPANCY DESCRIPTION:

01 S/B:SURFACES INDICATED SHALL BE FREE OF CORROSION.
IS:INTERGRANULAR CORROSION EXIST ON DOME & INS.BONDING SURFACE MULTIPLE AREAS WITH WORST CASE OF APPROX. 0.03"D.

02 S/B:THREAD PITCH SHALL BE 11.7793/11.7917".
IS:THE FOLLOWING CLOSURES ARE ALL UNDER MINIMUM REQUIREMENT & CHECK AS FOLLOWS:S/N W0442,10676,& 10658 IS 11.771";S/N 10633 & 10627 IS 11.772";10730,10668,10655,& 10663 IS 11.773";10706 & 10713 IS 11.774";& 10620 IS 11.775".

03 S/B:THREAD MAJOR DIAMETER 11.9027/11.9117".
IS:THE FOLLOWING S/N'S 10663,10627,10633,& W0442 CHECK 11.902".

DISPOSITION DESCRIPTION:

REPAIR. RISPW UNAFFECTED. REPAIR PER STANDARD REPAIR PROCEDURE 559X-BSM-001. CORROSION FALLS WITHIN LIMITS OF REPAIR PROCEDURE.

USE-AS-IS. RISPW UNAFFECTED. PER THE REVISED STRUCTURAL ANALYSIS SFK-12-88 FOR NCR D07308 WHICH HAD A CLOSURE WITH A THREAD PITCH DIAMETER OF 11.7692 INCHES, A MARGIN-OF-SAFETY OF + 0.099 EXISTED. ALL OF THE CLOSURE THREAD DIAMETERS ON THIS NCR ARE GREATER THAN THIS VALUE (CONT.) AND WILL THEREFORE HAVE MARGINS-OF-SAFETY GREATER THAN + 0.099 AND ARE ACCEPTABLE FOR USE-AS-IS.

USE-AS-IS. RISPW UNAFFECTED. THE THREAD SHEAR AREA PER THE REVISED ANALYSIS IN ITEM 2 OF THIS NCR HAS A POSITIVE MARGIN OF-SAFETY OF +0.099 FOR CLOSURES WITH THREAD PITCH DIAMETERS GREATER THAN 11.7692 INCHES. A MAJOR THREAD DIAMETER DISCREPANCY OF 0.0007 INCHES ON A DIAMETER WILL NOT (CONT.) AFFECT THE SHEAR AREA AND HENCE THE MARGIN-OF-SAFETY. THE FIT OF THE CLOSURES TO CASES WILL NOT BE AFFECTED BECAUSE THE CLOSURES HAVE ALREADY BEEN SUCCESSFULLY MATCHED TO CASES AND HYDROTESTED AS A SET.

CAUSE & CORRECTIVE ACTION

ITEM:	CAUSE CODE:	CAUSE NARRATIVE:	CA CODE:	CORRECTIVE ACTION NARRATIVE:
01	40	CLOSURES WERE IN STORAGE FOR 5 YRS FOLLOWING	40	MHC 8195 WAS CHANGED TO ASSURE PROPER PACKAGING OF

NCR: D12391 PLANT: COY DISC CAT: MT REF NO: N/A PR/MRB: MRB WC/OB: REPORT DATE: 01/06/94 PAGE: 1

DISC P/N: B12000-13-01-501
DISC P/NAME: DELTA QUAL MOTOR TEST(FWD
MFG PART NO: N/A
MFG PART NM: N/A
MFG SER NO: N/A
PLAN REL: MFGA 96533
PROJECT NO: 5597
BUILDING: 0485
WORK AREA: PBS

UOM: EA
LOT SIZE: 1
REJECT NO: 1
CAR/FRR:

NCR DATE: 10/11/93
DISPOSITION DATE: 10/19/93
CLOSE DATE: 10/22/93
DPRO COMMENTS: NO

PO: N/A
VENDOR NO: 000000
VEND NAME:
VEND DOC NO: N/A

INSPECTOR	MARK RADOVIC	10/15/93
VALIDATION	MIKE KISKILA	10/15/93
DISPOSITION	LARRY MURPHY	10/19/93
CAUSE/CA (UTC)	N/A	
CAUSE/CA (VEN)	MIKE KISKILA	10/19/93
QUAL DES ENGR	MIKE KISKILA	10/19/93
CUSTOMER	PAUL LUNDY	10/19/93
CUSTOMER		
GOVT REP	CLIFF SHERLOCK	10/19/93
MFG ENG REWORK	BECKY TIMEWELL	10/22/93
INSP ACCEPT	MARK RADOVIC	10/22/93

NCR NARRATIVE

ITEM INFORMATION

ITEM:	OPER NO:	AFF QTY:	SERIAL NO:	DWG SPEC:	DEFECT CODE:	RESP ORGN:	OCC/REC:	DISP CODE:	DISP QTY
01	PD003	1	1000738	B12001-02-01 4/H DN3	225 12	VEND	001	RP	1
02	PD003	1	1000738	B12001-02-01 4/F DN3	250 34	VEND	001	RP	1
03	PD003	1	1000738	B12001-02-01 4/H DN3	250 38	VEND	001	RP	1
04	PD003	1	1000738	MS51830	245 56	VEND	001	RP	1
05	D014	1	1000738	B12018-13-01 8/E	245 58	VEND	001	A	1
06	D014	1	1000738	B12003-06/05-01 6/E	245 58	VEND	001	A	1

DISCREPANCY & DISPOSITION

ITEM: DISCREPANCY DESCRIPTION:

01 S/B:SURFACES INDICATED SHALL BE FREE OF TOOL MARKS,TOOL CHATTER MARKS,NICKS,PITS,SCRATCHES,OR CORROSION.
IS:ONE OF THE .453-.457 DIA.THRU HOLES LOCATED @ 15 DEG. ALFCW EXHIBITS A 360 DEG.GOUGE ON THE I.D APPROX. 0.02"D.X 0.01" RAISED.

02 S/B:SAME AS ITEM # 1.
IS:CYLINDRICAL SECTION OF CASE EXHIBITS 10 SMALL IMPRESSIONS @ 260 DEG.ALFCW 5.5" AFT OF THE FWD EDGE WITH A WORST CASE DEPTH OF 0.003".THERE IS ALSO A SCRATCH @ 30 DEG. ALFCW 3.25 INCHES AFT OF FWD.EDGE APPROX. 0.13"L.X 0.0015"D.(CONT.) THE CYLINDRICAL SECTION ALSO EXHIBITS 3 NICKS APPROX. 3.0" FWD.FROM AFT END @ 190 DEG.FLACCW 0.1"L.X 0.02"W.X 0.003"D.

DISPOSITION DESCRIPTION:

REPAIR. RISPW UNAFFECTED. REPAIR BY ABRASION WITH 280 TO 400 GRIT ALUMINUM OXIDE PAPERAS REQUIRED TO REMOVE THE RAISED METAL AND BLEND WITH ADJACENT SURFACES. COAT REPAIRED AREA WITH ALODINE PER STANDARD PLANNING.
RATIONALE: THIS IS A TEST STAND MOUNTING HOLE TO PREVENT MOTOR MOVEMENT DURING FUNCTIONING. THIS AREA (CONT.) IS OUTSIDE OF THE PRESSURE CHAMBER AND AS SUCH IS IN A VERY LOW STRESS REGION. THE SLIGHT AMOUNT OF LOST MATERIAL WILL NOT RAISE THE STRESSES AND WILL NOT AFFECT THE FUNCTIONALITY OF THE MOTOR SKIRT. THE MOTOR WILL BE FIRED WITH TWO WEEKS SO CORROSION WILL NOT HAVE TIME TO AFFECT THE ALUMINUM. USE OF ALUMINUM OXIDE ABRASIVE WILL PREVENT IRON PARTICLES FROM BEING EMBEDDED IN THE ALUMINUM SURFACE WITH RESULTANT CORROSION.
REPAIR. RISPW UNAFFECTED. BLEND THE SMALL IMPRESSIONS AND SCRATCHED (GOUGED) AREAS PER THE FOLLOWING PROCEDURE:
1. REMOVE ANY RAISED METAL AND BLEND THE DISCREPANCIES BY ABRADING WITH 280 TO 400 GRIT ALUMINUM OXIDE PAPER PROGRESSIVELY. (CONTINUED)
2. QC MEASURE AND RECORD AMOUNT OF MATERIAL REMOVED.
3. QC VERIFY REMAINING CYLINDER WALL THICKNESS EXCEEDS MINIMUM DWG REQUIREMENTS OF 0.315 INCHES IN REPAIRED AREAS BY SUBTRACTING MAXIMUM AMOUNT OF MATERIAL REMOVED FROM THE ORIGINAL QC MEASURED AND RECORDED WALL THICKNESS OF 0.330 INCHES FOR MOTOR CASE 0511.

4. CLEAN AREAS WITH 1-1-1 TRICHLOROETHANE AND ALLOW TO DRY FOR 10 MINUTES MINIMUM. COAT REPAIRED AREAS WITH ALODINE PER STANDARD PLANNING.

RATIONALE:
IN THE REPAIRED AREAS THE REPAIR EDGES HAVE BEEN BLENDED WITH THE ADJACENT SURFACES SUCH THAT NO STRESS CONCENTRATIONS EXIST AND THE PRESSURE INTEGRITY OF THE MOTOR CASE WILL BE UNAFFECTED. NUMEROUS MOTORS HAVE BEEN SUCCESSFULL FLOWN WITH THIS TYPE OF AN ABRASIVE REPAIR IN THE MOTOR CASE CYLINDRICAL SECTION WHICH IS THE PRESSURIZED PORTION OF THE MOTOR CASE WITH THE THINNEST WALLS.

03 S/B:SAME AS ITEM # 1.
IS:THE FWD.FACE EXHIBITS INTERMITTENT & MULTIPLE VIBRATION/ CHATTER MARKS & UPSET METAL INDICATIONS 360 DEG.AROUND WITH THREE NOTICABLE AREAS IN BETWEEN 190-210 DEG. FLACCW MEASURING 0.56"L.X 0.30"W.X 0.003"D.,0.48"L.X 0.23"W.X 0.002"(CON) D.,& 0.45"L.X 0.24"W.X 0.0025"D.

REPAIR.RISPW UNAFFECTED. CLEAN THE DAMAGED AREAS WITH SCOTCHBRITE AND COAT WITH ALODINE PER STANDARD PLANNING.
RATIONALE: THE DAMAGED AREAS OF THE FWD FACE EXTEND RADIALLY OUTBOARD FROM THE ATTACH BOLT CIRCLE. THIS AREA IS THE THICKEST AREA OF THE PRESSURIZED PORTION OF THE MOTOR CASE AND GOES INTO COMPRESSION DURING MOTOR OPERATION WHEN THIS AREA ROTATES FROM THE CYLINDRICAL SECTION (->) THIN WALL PRESSURIZATION EFFECTS. THE EFFECTS OF THE UPSET METAL WILL NOT MEASURABLY INCREASE THE COMPRESSIVE STRESS IN THIESE AREAS. HENCE, THE PRESSURE INTEGRITY OF THE MOTOR WILL BE UNAFFECTED.

706

04 S/B:FLUSH TO 0.030" BELOW.
IS:ONE OUT OF FOUR LOCKING KEYS ON THE MS51830A203 INSERTS IS BACKED OUT& PROTRUDES ABOVE THE FWD.FACE DATUM @ THE FOLLOWING HOLES:TDC 0.003"R.,180 DEG. 0.002"R.,225 DEG.2 EA. KEYS 0.002"R.& 0.006"R.,AND 315 DEG. 0.003"R.

REPAIR. RISPW UNAFFECTED. REPAIR THESE DISCREPANCIES BY THE FOLLOWING PROCEDURE WHICH WILL RESEAT THE LUGS, TORQUE TEST THE KEENSERT INSERTS AND CHECK THEM WITH A THREAD GAGE.
REPAIR PROCEDURE:
1. RESEAT THE LOCKING KEYS ON THE NOTED INSERTS (CONT.) UNTIL FLUSH WITH INSERT FACE. RECORD KEENSERT LOCATION NUMBER.
2. QC MEASURE AND RECORD DEPTH OF KEENSERT BELOW SURFACE AND MARK MEASUREMENT POSITION WITH INK MARK FOR LATER MEASUREMENT.
3. INSTALL 5/16-24 SOCKET HEAD CAP SCREWS WITH THE PROPER NUMBER OF WASHERS UNDER THE SCREW HEADS TO PREVENT THEIR BOTTOMING OUT, USING MIL-T-83483 THREAD COMPOUND ON THE BOLT THREADS.
4. TORQUE BOLTS TO 165 TO 170 IN-LB AND RECORD THE FOLLOWING VALUES:
   RUNNING TORQUE:
   FINAL TORQUE:
5. QC MEASURE AND RECORD DEPTH OF KEENSERT BELOW SURFACE AT SAME POSITION AS BEFORE.
6. RECORD ANY KEENSERT DEPTH DIFFERENCE BETWEEN STEPS 1 AND 5. REPERFORM STEPS 2 - 6 IF DIFFERENCES ARE NOTED.
7. CLEAN KEENSERT THREADS WITH SWAB DAMPENED WITH 1-1-1 TRICHLOROETHANE.
8. REPORT RESULTS TO MATERIAL REVIEW BOARD IF ITEM 6 NOTES DEPTH DIFFERENCES AFTER TWO TORQUE TRIALS.

05 S/B:0.3125-24 UNJF

USE-AS-IS. RISPW UNAFFECTED. THE THREADED ATTACHMENT HOLES

IS:THE FOLLOWING HOLES ON THE FWD.FACE ACCEPT THE NO-GO ELEMENT ON THE THREAD GAGE WITH ORIENTATION FLACCW HOLE# 1 @ TDC:HOLE #1,#5,#7.

06 S/B:8-32 UNC-3B THRU 12 PLACES AS SHOWN.
IS:ONE OF THE NOZZLE HOLES IS BURRED UP & WILL NOT ACCEPT THE GO ELEMENT @ APPROX. 190 DEG.ALFCW.

WERE TORQUED TO 155 IN-LB DURING THE ENVIRONMENTAL TESTING AND FUNCTIONED ACCEPTABLY. SINCE THERE WAS NO MOVEMENT, THE INSERTS WILL FUNCTION ACCEPTABLY DURING STATIC FIRING. USE-AS-IS. RISPW UNAFFECTED. THE BURRS WERE DUR TO BOLT BEING INSTALLED W/O REMOVING THE PRIMER. THE TEST WAS COMPLETED SUCCESSFULLY WITH THE AEROHEAT SHIELD INSTALLED. THIS ATTACHMENT AREA IS NON-FUNCTIONAL DURING THE DELTA QUAL STATIC FIRING SINCE NOTHING WILL BE ATTACHED.

CAUSE & CORRECTIVE ACTION

ITEM:	CAUSE CODE:	CAUSE NARRATIVE:	CA CODE:	CORRECTIVE ACTION NARRATIVE:
01	13	DISCREPANCIES OCCURRED DUE TO HANDLING DAMAGE FROM TOOLING, FIXTURE INSTALLATION, AND MOTOR MOVES DURING THE ENVIRONMENTAL TESTING AT THE TEST VENDOR.	13	ANY FUTURE TEST VENDORS FOR ENVIRONMENTAL TESTING WILL BE DIRECTED BY P.O. REQUIREMENT TO ASSURE TOOLING FIXTURES WILL BE HANDLED AND INSTALLED TO PREVENT DAMAGE TO CASE WALL, FWD DOME, AND MOUNTING HOLES.
02	13	SAME AS ITEM #1.	13	SAME AS ITEM #1.
03	14	THE FORWARD DOME MARKS AND LOOSENING OF THE TREADED INSERT LOCKING LUGS ON S/N 1000738 WERE CAUSED DURING VIBRATION TESTING AT MSFC. DURING LIFT-OFF AND BOOST VIBRATION TESTING IN THE RADIAL AXIS, THE FASTENERS THAT HOLD THE BSM TO THE MOUNTING STRUCTURE LOOSENED. TWO OF THE FASTENERS BACKED COMPLETELY OUT. THE LOOSENED FASTENERS ALLOWED HIGH FREQUENCY MOVEMENT OF THE MOUNTING STRUCTURE RELATIVE TO THE BSM. THIS CAUSED THE BSM FORWARD DOME TO CHATTER AGAINST THE MOUNTING STRUCTURE. THE DYNAMIC LOADING IN THE LOOSENED JOINT CAUSED THE INSERT LOCKING LUGS TO TRANSLATE IN THE CASE. THE LOOSENING OF THE MOUNTING FASTENERS WAS MOST LIKELY CAUSED BY A COMBINATION OF TWO CHANGES IN THE SETUP (SINCE THE LAST DYNAMICS TEST ON A BSM AT MSFC, DEC, 1992). FIRST, GREASE WAS APPLIED TO THE FASTENERS PRIOR TO INSTALLATION. SECOND, THE FASTENERS WERE TORQUED AT ROOM TEMPERATURE (APPROX. 75 DEG F) AND THEN THE MOTOR AND MOUNTING STRUCTURE WERE CONDITIONED AT 130 DEG F WHEN TESTED. BOTH OF THESE CHANGES TO THE TEST SETUP (SINCE DEVELOPMENT) WERE REQUIRED TO SIMULATE THE FLIGHT INSTALLATION CONFIGURATION.	13	SAME AS ITEM #1.
			12	FUTURE DYNAMICS TESTING OF THE BSM SHALL INCORPORATE A LOCKING MECHANISM ON ALL FASTENERS (E.G. LOCKNUTS, LOCK WIRE). BSM S/N 1000734 WAS INSTALLED EXACTLY AS WAS DONE ON S/N 1000738 EXCEPT THAT THE BSM TO MOUNTING STRUCTURE FASTENERS WERE LOCKWIRED. THE FASTENERS RETAINED PRELOAD WHEN VIBRATED. NO CHATTER MARKS WERE NOTED ON THE FORWARD FACE AND THE THREADED INSERT LOCKING LUGS REMAINED SEATED ON S/N 1000734.
04	14	SAME AS ITEM #3.	12	SAME AS ITEM #3.
05	37	HOLE ENLARGEMENT OCCURRED AS A RESULT OF FUNCTIONAL TESTING.	30	NO CORRECTIVE ACTION REQUIRED. THERE IS NO REQUIREMENT FOR THREAD SIZE COMPLIANCE AFTER FUNCTIONAL TESTING.
06	37	DISCREPANCY OCCURRED BECAUSE THE BOLT WAS INSTALLED WITHOUT REMOVING THE PRIMER FROM THE HOLE THREADS.	30	NONE REQUIRED. THE TESTING IS COMPLETE. THIS IS A NON FUNCTIONAL ATTACHMENT AREA FOR THE DELTA QUAL MOTORS.

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NCR: D14416 PLANT: COY DISC CAT: MT REF NO: PR/MRB: MRB WC/OB: REPORT DATE: 11/11/94 PAGE: 1

DISC P/N: B12000-13-01-501
DISC P/NAME: BSM DELTA QUAL TEST, FWD
MFG PART NO: B12003-09-01
MFG PART NM: NOZZLE ASSY
MFG SER NO: W0442
PLAN REL: MFGA96533
PROJECT NO: 5597
BUILDING: 485
WORK AREA: PBS

UOM: EA
LOT SIZE: 1
REJECT NO: 1
CAR/FRR:

NCR DATE: 09/06/94
DISPOSITION DATE: 10/27/94
CLOSE DATE: 11/11/94
DPRO COMMENTS: YES

PO:
VENDOR NO: 000000
VEND NAME:
VEND DOC NO:

INSPECTOR	N/A	
VALIDATION	MIKE KISKILA	09/09/94
DISPOSITION	LARRY MURPHY	09/09/94
CAUSE/CA (UTC)	N/A	10/27/94
CAUSE/CA (VEN)	MIKE KISKILA	
QUAL DES ENGR	MIKE KISKILA	10/27/94
CUSTOMER	PAUL LUNDY	11/03/94
CUSTOMER		11/03/94
GOVT REP	CLIFF SHERLOCK	
MFG ENG REWORK	N/A	11/04/94
PURCH BUYER	N/A	11/04/94
INSP ACCEPT	ADRIAN RANDLES	11/04/94
		11/11/94

NCR NARRATIVE

ITEM INFORMATION

ITEM:	OPER NO:	AFF QTY:	SERIAL NO:	DWG SPEC:	DEFECT CODE:	RESP ORGN:	OCC/REC:	SIG:	DISP CODE:	DISP QTY:
01	N/A	1	1M738	CSD-5597-93-1 REV B	005 58	QACA	N		A	1

DISCREPANCY & DISPOSITION

ITEM: 01

DISCREPANCY DESCRIPTION:
S/B: DESIGN CHANGE SUCCESS CRITERIA SPECIFIES 90 MIL MAXIMUM EROSION DURING STATIC TEST.
IS: MEASURED EROSION OF 180 MILS.

DISPOSITION DESCRIPTION:
USE-AS-IS. RISPW UNAFFECTED. THE INSULATOR EROSION EXCEEDED THE 90 MIL REQUIREMENT AT THE INNER DIAMETER WHERE THE INSULATOR WRAPS OVER THE EDGE OF THE ALUMINUM CLOSURE. THE MAXIMUM EROSION OCCURRED AT 0 DEGREES (ALF) AT THE POINT OF MAXIMUM CLOSURE SUBMERGENCE. THE TEST RESULTS ARE ACCEPTABLE. ALTHOUGH THE SUCCESS CRITERIA OF 90 MIL. MAX EROSION AS DEFINED IN THE QUALIFICATION TEST PLAN WAS NOT MET, VISUAL INSPECTION SHOWED THE INSULATORS REMAINED BONDED AND FULLY ATTACHED FOR THE FULL 360 DEGREE CIRCUMFERENCE AND NO AREAS OF ABNORMAL ABLATION WERE FOUND AS COMPARED TO THE SECONDARILY BONDED INSULATION CONFIGURATION. VIRGIN RUBBER REMAINED AT ALL LOCATIONS ON THE CLOSURE. BASED UPON POST-TEST MEASUREMENTS, A CONSERVATIVE CALCULATION OF INSULATOR SAFETY FACTOR SHOWS 1.33 AND 1.38 FOR THE TWO QUALIFICATION BSMS WHICH COMPLIES WITH THE FACTOR OF SAFETY REQUIREMENT (1.25) OF 10SPC-0067 PARA. 3.2.1.2.3.7 (REFERENCE "BSM DELTA QUALIFICATION 2 FINAL REPORT" PARAGRAPH 6.3.3), HOT 120 DEGREE MOTOR.

CAUSE & CORRECTIVE ACTION

ITEM:	CAUSE CODE:	CAUSE NARRATIVE:	CA CODE:	CORRECTIVE ACTION NARRATIVE:
01	10	THE DESIGN DOES NOT MEET THE PERFORMANCE GOAL ESTABLISHED IN THE DELTA QUALIFICATION 2 TEST PLAN.	30	NO CORRECTIVE ACTION REQUIRED. THE TEST RESULTS HAVE BEEN DETERMINED TO COMPLY WITH 10SPC-0067 DESIGN REQUIREMENTS. REFERENCE DISPOSITION RATIONALE.

BSM TECHNICAL
ACTION ITEM
RESPONSE SHEET

TOPIC:	SUBMITTED BY/AGENCY:	DATE:	NO:
O-ring Seating tests	USBI-BPC	8/25/87	026

ACTION ITEM: Determine by pneumatic pressure testing the seating pressure required to seat primary O-rings. Generate test plan and support test activity. Write Engineering letter report summarizing results.

Reference Action Items 005 and 025.

VOR NUMBER:	ACTION, ASSIGNEE: Warren Burks RESOLVER: Warren Burks	DATE SUBMITTEI
96-630-0000		

ACTION RESPONSE:

Seating of the aft primary O-ring verified by using real time X-ray. Test plan generated and submitted as part of action item 005. The test report was also generated and attached to this action item

SUMMARY OF RESULTS

The aft primary O-ring seats at or before 40 psig even under the following conditions.

A. When it is cut.
B. When other primary or secondary O-rings are missing in the motor.

SD APPROVAL - PROJECT ENGINEERING:	DATE APPROVED:
PROGRAM MANAGEMENT:	10-9-87

TEST REPORT

BSM O-RING SEATING TESTS

USING REAL TIME X-RAY AS VERIFICATION MEDIUM

PREPARED BY:

W. R. Burks 9/28/87
Design Engineer
TVC Systems

APPROVED BY:

J. Wackerman 9-29-87
Group Head
TVC Systems

L. O. Murphy 10-1-87
BSM Chief Engineer

R.S. Truman 10/6/87

T. V. O'Hara 10/6/87
BSM Program Manager

1.0 SUMMARY

This test report describes the testing accomplished using a real time X-ray imaging system to verify a pressure at which the aft primary o-ring in the Booster Separation Motor (BSM) seats. The O-ring was considered seated when it moved to the aft wall of the O-ring gland. In addition to the real time X-ray tests, twenty-seven tests were performed to identify chamber leak rates when various O-rings were missing.

2.0 TEST SET-UP

To perform the tests, a real time X-ray lab (Schonberg Radiation in Santa Clara) was used. The test set-up consisted of a BSM motor case, aft closure, nozzle throat plug, forward closure, used TBI's, and chamber pressure port plug (Figure 1). All test hardware met applicable drawing tolerances. The tabulated results of a dimensional check of the test hardware is shown in Appendix 1.A gaseous nitrogen bottle was used with the necessary plumbing (Figure 1) to pressurize the chamber. The X-ray imaging equipment is shown in Figure 2, in the test set-up configuration. All O-rings used in these tests were inspected and accepted per Mil-STD-413C.

3.0 TEST PROCEDURE

3.1 Chamber Leak Rates

Prior to the real time X-ray tests, twenty-seven tests (test group A) were performed to reveal motor chamber leak rates when

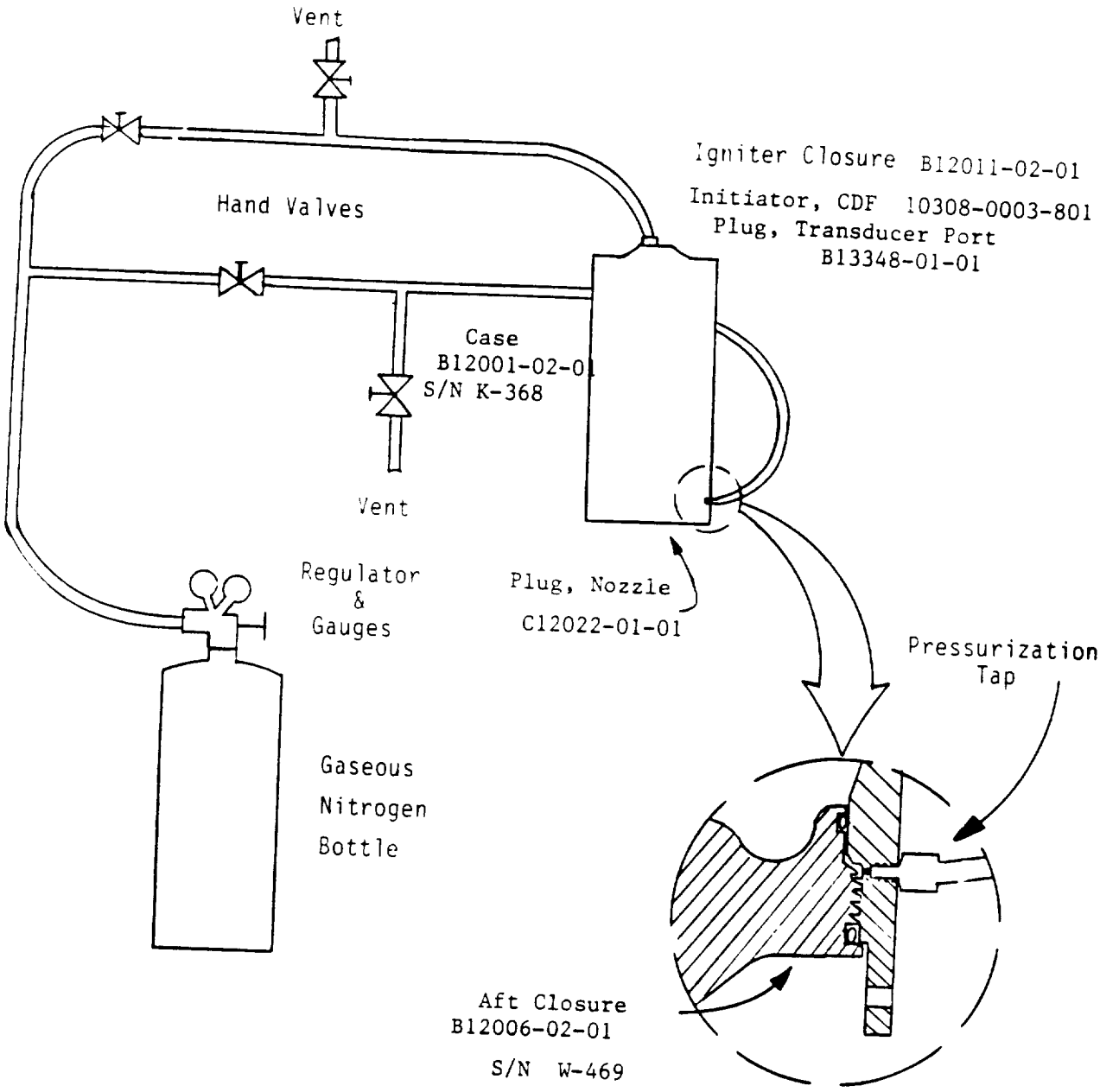


Figure 1. BSM Test Equipment and Test Set-Up.

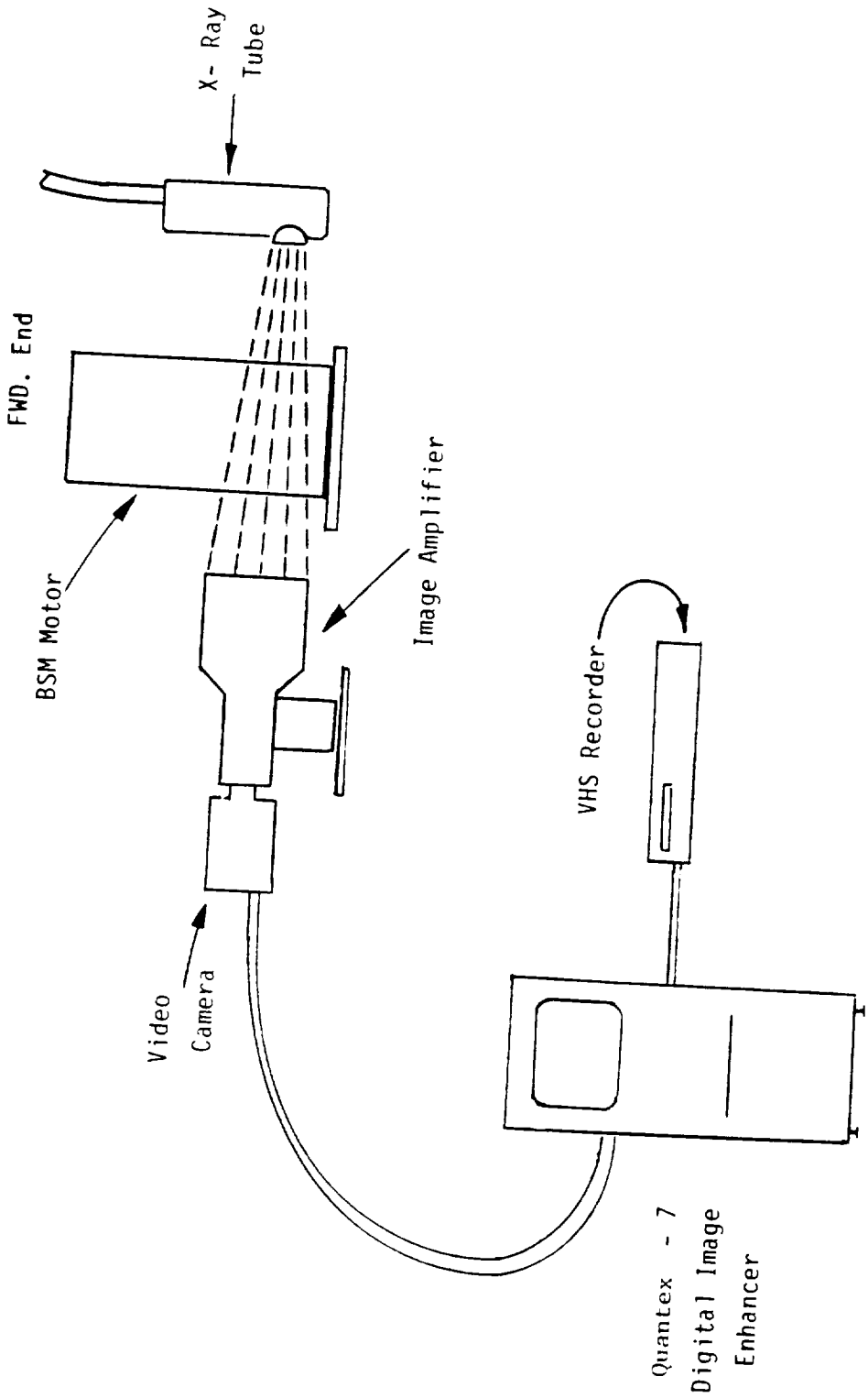


Figure 2 Schonberg Radiations Real Time X-ray Imaging Equipment.

varying combinations of O-rings were NOT installed in the motor. In each test, the motor case was assembled per W.I. B07.1.001 with the selected O-rings missing as listed in the Test Plan Matrix, Table 1. The motor chamber was then pressurized to 25, 50, and 90 psig (see Table 1), and held for one minute. The motor chamber was vented following the completion of the nine tests in each test group. If there was a pressure drop between runs, the chamber pressure was boosted back to the chosen pressure. If there was no pressure drop between runs, the final pressure was logged at the end of the one minute test, and the clock was started for the next run. Initial and final pressures were logged to an individual test data sheet following each run.

3.2 O-Ring Seating Tests

The remaining tests (test groups B through E) conformed to the assembly procedures listed in paragraph 3.1. Various O-rings for each test group were missing or cut in the motor assembly as listed in Table 1, Test Plan Matrix.

Test group B through E followed a similar procedure to that used for test group A. To move the primary aft O-ring to its forward most position in the O-ring gland, the pressurization tap in the motor case was pressurized to 90 psig and held for 30 seconds, then vented. The X-ray imaging equipment was then activated with the primary O-ring in its most forward position. The valve to the pressurization tap was then closed prior to motor chamber pressurization through a tapped hole in the forward skirt. An X-ray image of the motor assembly with the primary aft

TEST GROUP	REPS	TEST NUMBER	PRESSURE (Psig)	TIME	AFT PRIMARY	AFT SECONDARY	FORWARD PRIMARY	FORWARD SECONDARY	Pc PRIMARY	Pc SECONDARY	TBI PRIMARY	TBI SECONDARY
A	3	A-1-25	25.0	1 min	X	X	O	O	X	X	O	O
	3	A-1-50	50.0	1 min	X	X	O	O	X	X	O	O
	3	A-1-90	90.0	1 min	X	X	O	O	X	X	O	O
	3	A-2-25	25.0	1 min	X	X	X	X	O	O	X	X
	3	A-2-50	50.0	1 min	X	X	X	X	O	O	X	X
	3	A-2-90	90.0	1 min	X	X	X	X	O	O	X	X
	3	A-3-25	25.0	1 min	O	O	X	X	X	X	X	X
	3	A-3-50	50.0	1 min	O	O	X	X	X	X	X	X
	3	A-3-90	90.0	1 min	O	O	X	X	X	X	X	X
B	3	B-1	0-90.0		X	X	X	X	X	X	X	X
C	3	C-1	From	1 min	X	O	X	X	X	X	X	X
	3	C-2	Test	1 min	X	X	X	O	X	X	X	X
	3	C-3	Group B	1 min	X	X	X	X	X	O	X	X
D	3	D-1	"	1 min	O	X	X	X	X	X	X	X
	3	D-2	"	1 min	X	X	O	X	X	X	X	X
	3	D-3	"	1 min	X	X	X	X	O	X	X	X
E	3	E-1	"	1 min	CUT[1]	O	X	X	X	X	X	X
	3	E-2	"	1 min	X	X	CUT[2]	O	X	X	X	X

TEST GROUPS:

A- CHAMBER LEAK RATES

B- SEATING TESTS, 30 PSIG

C- SEATING TEST, 40 PSIG, NO SECONDARY O-RINGS

D- SEATING TEST, 40 PSIG, NO PRIMARY O-RINGS

E- SEATING TEST, 40 PSIG, CUT AND MISSING O-RINGS

"X" indicate an O-ring

"O" indicate a missing O-ring

Cut[1]= $\frac{0.020}{0.014}$ Gap Length 0.045 ± 0.010 Gap Depth

Cut[2]= $\frac{0.020}{0.014}$ Gap Length 0.035 ± 0.010 Gap Depth

Table 1. Test Plan Matrix

O-ring in its forward position (view 1) was frozen on the monitor screen. For the three tests in group B, the motor chamber pressure was slowly increased from 0 psig until the primary aft O-ring began its movement which began at 15 psig. The primary aft O-ring reached its seated position once the pressure reached 30 psig. To verify the O-ring seated at 30 psig the pressure was increased to 90 psig with no additional movement seen. Following each run of the twenty-seven tests in groups B through E, the chamber was vented and the aft primary O-ring was moved back to its forward position. This test was repeated three times to assure conclusive results. The remaining test groups (C through E), used a pressure with a 1.3 margin over the 30 psig as a seating pressure. The initial pressure of 40 psig, and final pressures were recorded to verify if any leakage occurred due to missing or cut O-rings.

4.0 TEST RESULTS

Test group A yielded results that showed the assembled BSM motor only leak path at low pressure (90 psig max) is through the forward closure and/or TBI ports (test group A-1-25,50,90). Previous testing has shown the TBIs, when installed without O-rings, and properly torqued, do not leak at pressures in excess of 1990 psig GN2. (Reference document, CSD-TR-2700-01-86). Therefore, all leakage was past the forward closure, case interface. The worst case pressure drop was from 89.8 to 85.2 psig over a one minute time span. Test group A-2-25,50,90 verified there is leakage past the plug in the transducer port.

The leakage was very small (1 psig over one minute was the worst), but it was consistent. Test group A-3-25,50,90, proved there is no leakage through the aft end when the aft closure is installed with no O-rings. Two tests showed a pressure drop, for that configuration, of 90.0 to 89.2 psig, and 50.0 to 49.7 psig, over a one minute time span. Both of these tests were the first of a series of three and the pressure drop was due to a cool down of the chamber after a rapid pressurization. This conclusion can be drawn because the next two tests in each group did not require a large volume of gas from the N2 source to boost it back to the selected pressure (50 and 90 psig), and did not show a pressure drop. Table 2 is the Test Result Matrix for test group A.

Test groups B, C, and E verified the aft primary O-ring seats itself at or before 40 psig even when other primary and secondary O-rings through out the motor are missing. This was confirmed by twenty-one tests in which the actual movement of the aft primary O-ring was video taped from the real time X-ray image. In each run there was a slight pressure drop. Again this drop was due to a cool down of the motor chamber. Table 3, is the Test Result Matrix for test groups B through E.

An attempt was made to view the forward primary O-ring seat in test group C-2, but the installation of the forward closure pushes the forward primary O-ring to its seated position. The chamber pressure was raised to 90 psig with the real time X-ray activated, video recording, and the forward primary O-ring did

TEST NUMBER	RUN NUMBER	TIME	Pc Initial (PSIG)	Pc Final (PSIG)	Δ Pc (PSIG)
A-1-25	1	1 min	25.0	24.4	0.6
	2	1 min	25.0	24.4	0.6
	3	"	25.0	24.4	0.6
A-1-50	1	"	50.0	48.0	2.0
	2	"	49.5	47.7	1.8
	3	"	50.0	48.0	2.0
A-1-90	1	"	89.9	85.2	4.7
	2	"	90.0	86.0	4.0
	3	"	90.0	85.7	3.3
A-2-25	1	"	25.0	24.0	1.0
	2	"	25.0	25.0	-
	3	"	25.0	25.0	-
A-2-50	1	"	50.0	49.9	0.1
	2	"	50.0	50.0	-
	3	"	50.0	50.0	-
A-2-90	1	"	90.0	89.4	0.6
	2	"	90.0	89.9	0.1
	3	"	90.0	89.9	0.1
A-3-25	1	"	25.0	25.0	-
	2	"	25.0	25.0	-
	3	"	25.0	25.0	-
A-3-50	1	1 min	50.0	49.7	0.3
	2	"	50.0	50.0	-
	3	"	50.0	50.0	-
A-3-90	1	"	90.0	89.2	0.8
	2	"	90.0	90.0	-
	3	"	90.0	90.0	-

Table 2. Test Result Matrix, Test Group A.

TEST NUMBER	RUN NUMBER	Pc INITIAL (PSIG)	Pc FINAL (PSIG)	Δ Pc (PSIG)	REAL TIME RECORDING	SEATING PRESSURE	O-RING VIEWED
B-1	1	N/A	N/A	–	X	30.0	aft prim
	2	N/A	N/A	–	X	30.0	"
	3	N/A	N/A	–	X	30.0	"
C-1	1	40.5	40.0	0.5	X	40.0	"
	2	40.3	40.0	0.3	X	"	"
	3	40.0	40.0	–	X	"	"
C-2	1	40.0	40.0	–	X	"	ign prim
	2	40.0	39.9	0.1		"	
	3	40.0	40.0	–		"	
C-3	1	40.0	39.5	0.5	X	"	aft prim
	2	40.0	40.0	–	X	"	"
	3	40.0	39.5	0.5	X	"	"
D-1	1	40.0	40.0	–	X	"	aft sec
	2	40.0	40.0	–		"	
	3	40.0	40.0	–		"	
D-2	1	40.0	39.5	0.5	X	"	aft prim
	2	40.0	39.5	0.5	X	"	"
	3	40.0	39.5	0.5	X	"	"
D-3	1	40.0	39.5	0.5	X	"	"
	2	40.0	39.5	0.5	X	"	"
	3	40.0	39.9	0.1	X	"	"
E-1	1	40.0	39.5	0.5	X	"	"
	2	40.0	39.5	0.5	X	"	"
	3	40.0	39.5	0.5	X	"	"
E-2	1	40.0	39.5	0.5	X	"	"
	2	40.0	39.5	0.5	X	"	"
	3	40.0	39.5	0.5	X	"	"

Table 3. Test Result Matrix , Test Groups B Through E.

not move. An attempt was also made to view the aft secondary O-ring seat when the aft primary was missing in test group D-1, but the closure at that region was too dense to pick up any movement.

5.0 CONCLUSION

Test group A-1-25,50,90 verified the worst case leak path of the BSM motor is through the forward closure when the forward closure is installed with no O-rings. Test group A-2-25,50,90 verified there is slight leakage past the plug in the transducer port when it is installed with no O-rings. Test group A-3-25,50,90 proved there is NO leakage past the aft closure when it is installed with no O-rings. The buttress threads and the high assembly torque (600 ft.-lb.) of the aft closure seal the motor cavity.

Test groups B, C, and E proved the aft primary O-ring seats at or before 40 psig. The aft primary O-ring seating pressure is unaffected by other missing primary or secondary O-rings. Test group E (cut primary, no secondary) confirmed a cut aft primary O-ring seats at or before 40 psig, and no leakage is detectable during a one minute test. In addition the BSM motor does not leak when the mating primary or secondary O-ring of the pair is missing. This applies to every pair of O-rings in the BSM motor.

INSPECTION RESULTS OF BSM MOTOR CASE DWG. # B12001-02-01
SERIAL # K368

Dimension Per DWG. B12001-02-01	Dimension of Case # K368	Location
ø 11.970 / 11.966	0°= 11.966 90° = 11.967 45°= 11.970 135°= 11.964 Average = 11.967	Secondary o-ring sealing surface.
ø 11.570 / 11.568	0°= 11.568 90°= 11.568 45°= 11.571 135°= 11.565 Average = 11.568	Primary O-ring sealing surface
ø 11.8124 / 11.8000	0°= 11.8032 90°= 11.8012 45°= 11.8052 135°= 11.8002 Average = 11.8002	Pitch Diameter of threads.

INSPECTION RESULTS OF BSM MOTOR CLOSURE DWG # B12006-0x-01
SERIAL # W469

Dimension per DWG. B12006-0x-01	Dimension of Closure # W469	Location
ø 11.536 / 11.530	0°= 11.531 90°= 11.532 45°= 11.531 135°= 11.531 Average= 11.531	Fwd. lip of closure.
ø 11.536 / 11.564	0°= 11.564 90°= 11.564 45°= 11.564 135°= 11.565 Average= 11.565	Sealing surface just aft of prim o-ring gland.
ø 11.234 / 11.232	0°= 11.235 90°= 11.232 45°= 11.232 135°= 11.233 Average= 11.234	Primary O-ring gland I.D.
.281 / .286	0°= .282 90°= .282 45°= .282 135°= .282 Average = .282	Primary O-ring gland width.

Appendix 1. Dimensional Check of Case & Closure Test Results.
11

Dimension per DWG. B12006-0x-01	Dimension of Closure # W469	Location
Ø 11.627 / 11.625	0°=11.624 90°=11.626 45°=11.625 135°=11.625 Average= 11.625	Secondary O-ring Gland I.D.
.281 / .286	@ 180° 0.283 MAX	Secondary O-ring gland width.
Ø 11.7917 / 11.7793	0°= 11.7872 90°=11.7882 45°= 11.7872 135°=11.7872 Average= 11.7875	Pitch diameter of threads.
Ø 11.9117 / 11.9027	0°= 11.905 90°=11.906 45°= 11.906 135°= 11.906 Average= 11.906	Major diameter of threads

Appendix 1. Cont.

INTERNAL CORRESPONDENCE

UNITED TECHNOLOGIES
CHEMICAL SYSTEMS

To: Brian Hammond

Fm: F.M. Payne

Cc: B. Atkinson, L. Murphy, M. Delaney, C. Skrocki, C. Daniels, J. Tracy, T.V. O'Hara

Subj: Interim Test Report for Qualification of Vulcanization Process for BSM Aft Closure Insulator Bonding

Ref: Test Plan for Qualification of Vulcanization Process for BSM Aft Closure Insulator Bonding (Section 5.2), CSD DTP-5597-001 dated 12 April 93, Revision NC

Dt: 6/21/93

No: FMP-01-93E

INTRODUCTION

The purpose of this memo is to provide an interim report for the testing completed to date in accordance with the "Test Plan for Qualification of Vulcanization Process for BSM Aft Closure Insulator Bonding", CSD DTP-5597-001. As of June 11, 1993 the following activities had been accomplished:

1) Fabrication and Testing of Baseline (EA 913NA/L-3), Adhesive Candidate and Confirmation Panels (Chemlok 805 & 855 only)
2) Fabrication of Aging Panels
3) Fabrication and Testing of Demonstration Aft Closure Assemblies and co-processed panels

SUMMARY OF RESULTS

The results of the Baseline tests are shown in table I. Note that the Baseline peel interfaces exhibit areas where contact was not achieved during bonding. It is impossible to obtain uniform pressure at all locations using a mechanical i.e., clamping method. The same conditions (lack of contact or "unbonds") exist in the aft closure insulator bond using the current method for the same reason. The was no evidence of lack of contact in the vulcanization bonded panels.

The Adhesive Candidate (Chemlok 805 & 855 only) test results are shown in table II and depicted graphically in figure 1. Confirmation Panel results are shown in table III. The Chemlok 205/220 testing was deleted. This system was carried as a back-up for risk-reduction. The satisfactory results obtained with the water-based, Chemlok 805/855 system made this additional

testing unnecessary. All test results meet the success criterion of a peel strength of greater than 25 pounds per linear inch (PLI). In addition, the failure modes for the Chemlok 805 & 855 panels are almost entirely cohesive in the rubber. Out of the 115 vulcanization bond samples, which includes the co-processed panel results, only four did not exhibit 100% cohesive failure. The lowest percentage of cohesive failure of these four was 80%. This shows that the vulcanization bond strength exceeds the rubber strength. Based on the Adhesive Candidate and Confirmation results, the process limits were selected in accordance with the test plan. The selected limits are as follows:

Process factor	Low Limit	High Limit
Cure Time	1 hour	4 hours
Relative Humidity	none	85%
Dry Times (primer & adhesive)	20 minutes	*
Dry Temperature	60 deg F	85 deg F
Cure Pressure	160 psig	200 psig

*- High Limit to be determined during Demonstration Phase (panel still in process)

Using these process limits and the Chemlok 805/855 system, the six demonstration aft closure assemblies were fabricated in accordance with the test plan.

The post fabrication examination results from the six demonstration closures were also very positive. The insulation surface formed by the rubber forming ring and vacuum bag bleeder cloth was still smooth enough to be easily ultrasonically inspected. No unbonds were found in any of the six units using tap testing and ultrasonic inspection. On units 3, 5 & 6, there were several areas which were not inspectable at the throat entrance due to the surface profile of the insulator. The areas are displayed in figures 2 and 3. These units had been reclaimed from static test hardware and the ablated contour of the throat entrance caused the uneven rubber surface. Units 2 & 4 also exhibited a rubber surface profile which was not inspectable. It occurred at BDC at the transition between the forward tip of the throat entrance and the bowl of the closure (see figures 4 and 5). This was the result of cut-outs in the rubber forming ring which is inserted under the vacuum bag and used to contour the insulator during autoclave cure. Eliminating the cut-outs eliminated the condition. Rubber forming rings with cut-outs will no longer be used.

There were minor edge separations noted during the edge bond inspection but they met the existing drawing criterion of .125 inch maximum depth. The co-processed peel panel test results are shown in Table IV. Again all test results exceeded 25 PLI. An additional peel panel was co-processed up to the point of adhesive application with units 3 & 4. This panel is to be used for dry time upper limit demonstration and has not yet completed testing due to its extended processing cycle time. Based on the acceptable ultrasonic, tap, edge inspection and peel results, a destructive evaluation of the closure bond was not conducted.

The dimensional inspection of the outside lip met all drawing requirements on units 1 & 3-6 with the exception that all units would require some trimming of the insulation outer diameter to be flush to the outside diameter of the closure. On unit 2, there were four locations which would require filling with RTV 102 to meet drawing requirements. These four locations were found to coincide with the four sprue holes in the insulator mold. Better control of the mold fill and restriction of the rubber flow from the sprue holes eliminated the condition on subsequent units (units 3, 4, 5 & 6).

CONCLUSIONS

Based on the successful fabrication and testing of the Baseline, Adhesive Candidate, Confirmation and co-processed panels and fabrication and evaluation of demonstration aft closure assemblies, CSD is ready to develop design and processing documents and to fabricate the Delta Qualification aft closure assemblies.

F. M. Payne
Design Engineer

TABLE I

BASELINE

PEEL VALUES (PLI)

@ 75 DEG F

PANEL # / SAMPLE #	1	2
1	105	90
2	97	90
3	95	86
4	92	81
5	92	87
MEAN VALUE	96.2	86.8

@ 130 DEG F

PANEL # / SAMPLE #	1	2
1	85	72
2	85	71
3	73	72
4	82	70
5	78	81
MEAN VALUE	80.6	73.2

PERCENT COHESIVE FAILURE *

@ 75 DEG F

PANEL # / SAMPLE #	1	2
1	100	100
2	100	100
3	100	100
4	100	100
5	100	100
MEAN VALUE	100	100

@ 130 DEG F

PANEL # / SAMPLE #	1	2
1	100	100
2	100	100
3	100	100
4	100	100
5	100	100
MEAN VALUE	100	100

* - APPLIES TO CONTACT AREA, BASELINE PANELS EXHIBITED LACK OF CONTACT AT PEEL INTERFACES, AREA OF LACK OF CONTACT IN PERCENT IS AS FOLLOWS:

@ 75 DEG F

PANEL # / SAMPLE #	1	2
1	0	5
2	5	0
3	10	10
4	5	20
5	2	20
MEAN VALUE	4.4	11

@ 130 DEG F

PANEL # / SAMPLE #	1	2
1	20	10
2	25	20
3	40	40
4	10	10
5	0	15
MEAN VALUE	19	19

TABLE II

ADHESIVE CANDIDATE
PEEL VALUE (PLI)

DESIGN NUMBER / SAMPLE #	1	2	3	4	5	6	7	8	9	10
1	95	86	91	99	118	88	78	89	92	90
2	98	89	92	102	103	79	80	88	98	90
3	100	81	94	109	112	88	80	96	96	92
4	97	82	93	113	98	88	83	95	100	98
5	87	85	96	103	95	88	83	96	99	102
MEAN VALUE	95.4	84.6	93.2	105.2	105.2	86.2	80.8	92.8	97	94.4

PERCENT COHESIVE FAILURE

DESIGN NUMBER / SAMPLE #	1	2	3	4	5	6	7	8	9	10
1	100	100	100	100	100	100	100	100	100	100
2	100	100	100	100	100	100	100	100	100	100
3	100	100	100	100	100	100	100	100	100	100
4	95	100	100	100	100	100	100	100	100	100
5	80	100	100	100	100	100	100	100	100	100
MEAN VALUE	95	100	100	100	100	100	100	100	100	100

TABLE II (CONT)

ADHESIVE CANDIDATE
PEEL VALUE (PLI)

DESIGN NUMBER	10	11	12	13	14	15	16
SAMPLE #							
1	90	96	79	110	95	80	104
2	90	95	86	105	91	90	98
3	92	93	87	103	96	76	104
4	98	96	85	97	101	74	104
5	102	92	85	91	94	78	108
MEAN VALUE	94.4	94.4	84.4	101.2	95.4	79.6	103.6

PERCENT COHESIVE FAILURE

DESIGN NUMBER	10	11	12	13	14	15	16
SAMPLE #							
1	100	100	100	100	100	100	100
2	100	100	100	100	100	100	100
3	100	100	100	100	100	100	100
4	100	100	100	95	100	100	100
5	100	100	100	85	100	100	100
MEAN VALUE	100	100	100	96	100	100	100

FIGURE 1

RESULTS OF ADHESIVE CANDIDATE TESTING

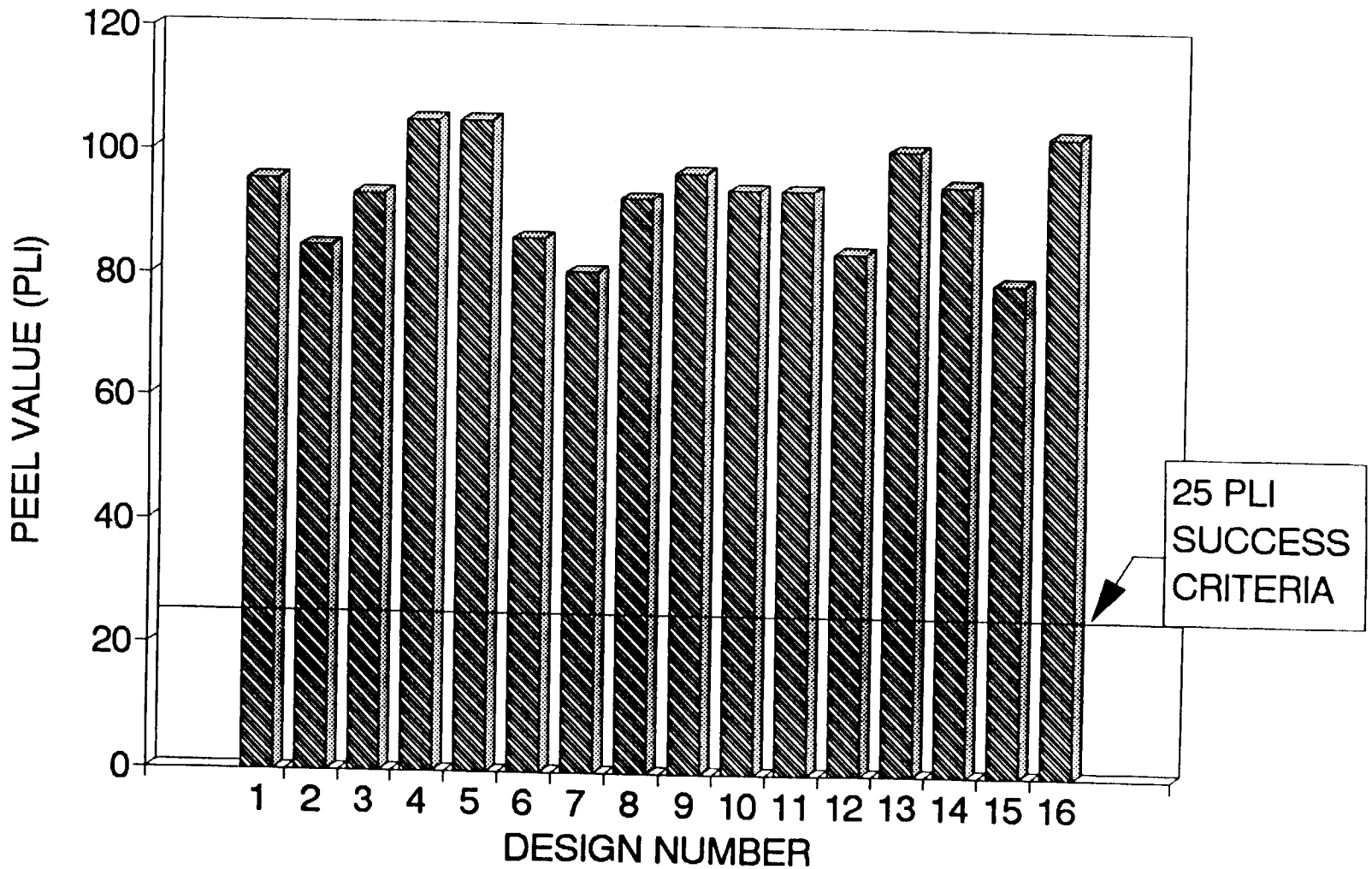


TABLE III

CONFIRMATION TESTS
PEEL VALUES (PLI)
@ 75 DEG F

PANEL # / SAMPLE #	1	2
1	104	84
2	100	94
3	108	98
4	96	98
5	97	93
MEAN VALUE	101	93.4

@ 130 DEG F

PANEL # / SAMPLE #	1	2
1	86	83
2	88	78
3	83	78
4	88	95
5	86	88
MEAN VALUE	86.2	84.4

PERCENT COHESIVE FAILURE
@ 75 DEG F

PANEL # / SAMPLE #	1	2
1	100	100
2	100	100
3	100	100
4	100	100
5	100	100
MEAN VALUE	100	100

@ 130 DEG F

PANEL # / SAMPLE #	1	2
1	100	100
2	100	100
3	100	100
4	100	100
5	100	100
MEAN VALUE	100	100

TABLE IV

CO-PROCESSED PANEL TESTS
PEEL VALUE (PLI)

UNIT # / SAMPLE #	4	5	6*
1	88	94	125
2	90	100	83
3	90	97	94
4	89	96	93
5	90	104	78
MEAN VALUE	89.4	98.2	94.6

PERCENT COHESIVE FAILURE

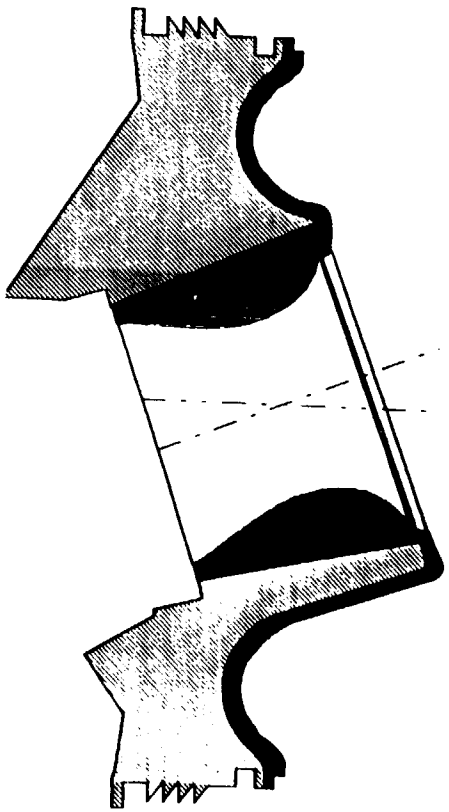
UNIT # / SAMPLE #	4	5	6
1	100	100	100
2	100	100	100
3	100	100	100
4	100	100	100
5	100	100	100
MEAN VALUE	100	100	100

* - PANEL NOT FABRICATED PROPERLY;
PEEL STRIP WAS OF INSUFFICIENT LENGTH
RESULTING IN SOME ANOMALOUSLY HIGH
VALUES DUE TO TENSION FAILURE OF RUBBER.

FIGURE 2
NON-INSPECTABLE AREAS

S/N 3

ATTACH NDT REPORT TO THIS JRP.



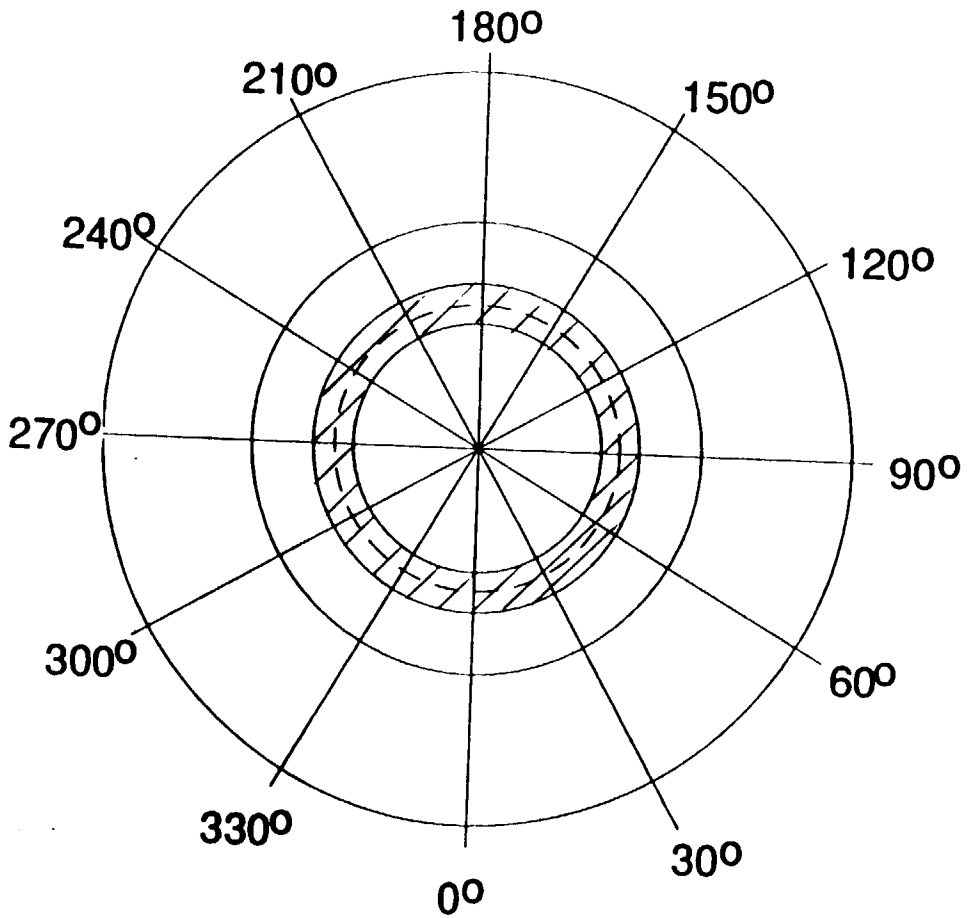
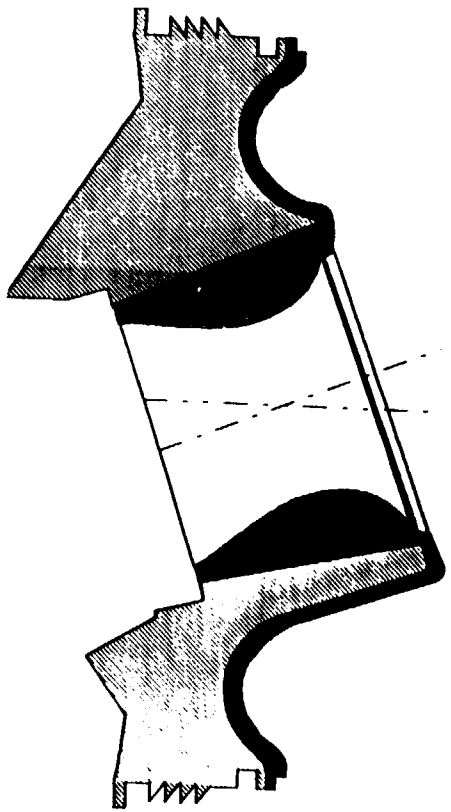


FIGURE 3
NON-INSPECTABLE AREAS

S/N 5,6

ATTACH NDT REPORT TO THIS JRP.



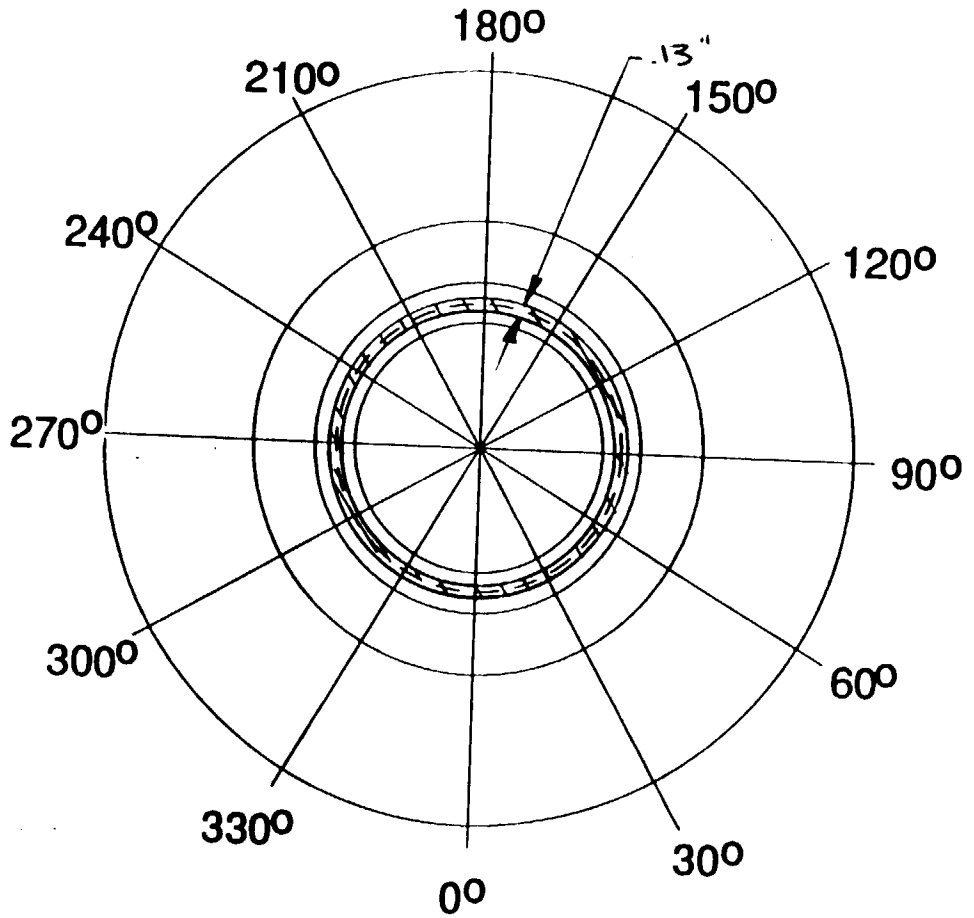
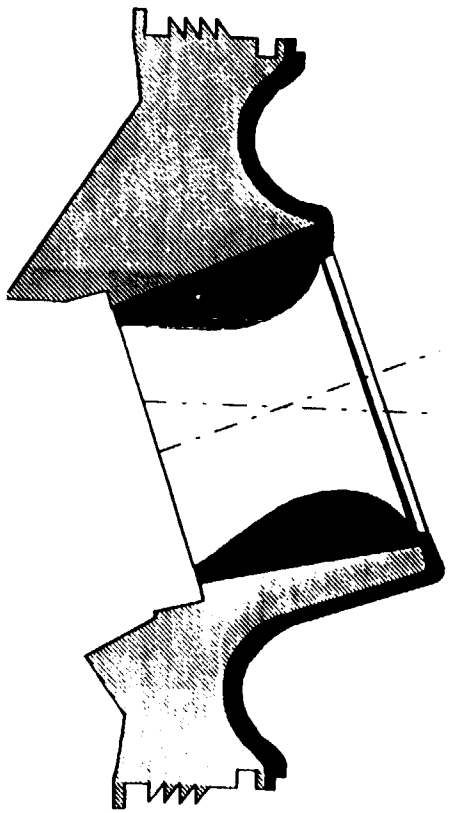


FIGURE 4

NON-INSPECTABLE AREAS

S/N 2

ATTACH NDT REPORT TO THIS JRP.



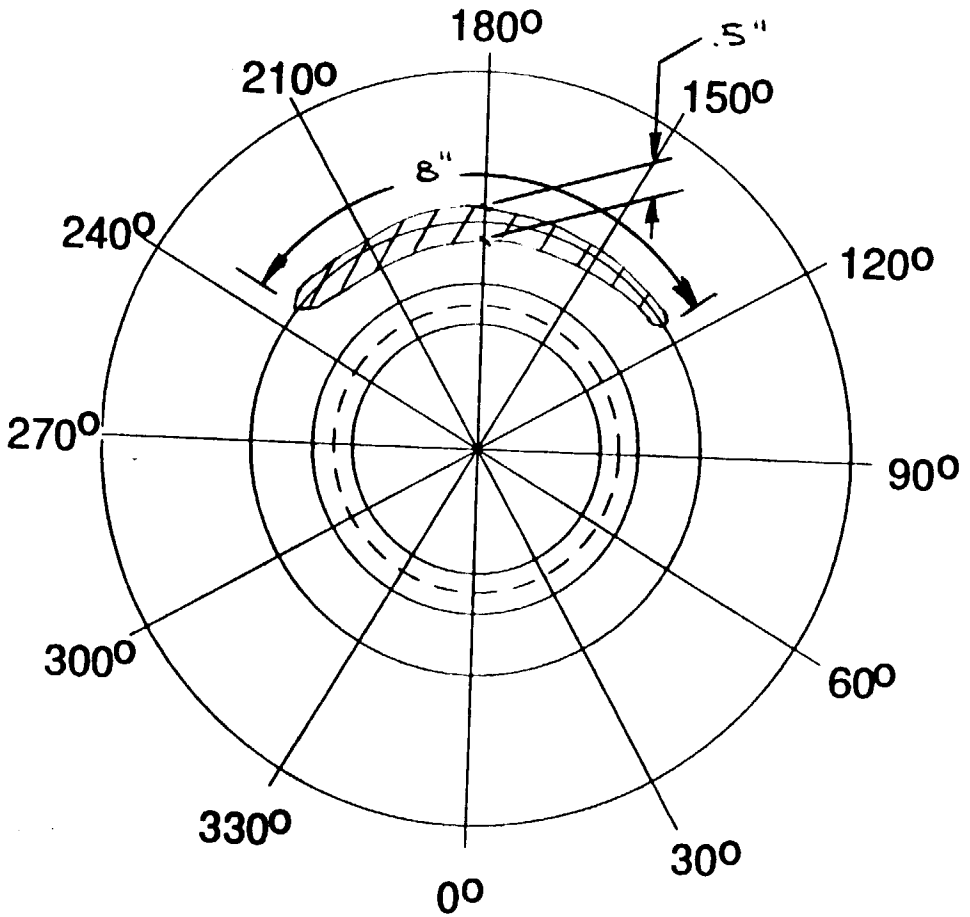


FIGURE 5
NON-INSPECTABLE AREAS

S/N 4

ATTACH NDT REPORT TO THIS JRP.

